INSTRUCTION MANUAL

INTERFERENCE ANALYZER

MODEL

CPR-25

10KHz - 1000MHz

ELECTRO-METRICS

A PENRIL COMPANY

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INSTRUCTION MANUAL

FOR

INTERFERENCE ANALYZER

MODEL CPR-25

ELECTRO-METRICS

762-2600

100 Church Street • Amsterdam, New York 12010 • (518) 843-2600

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Receiver does not fully comply [illegible]
requirements. VSWR does not comply & does not
pass CISPR pulse when in Q.P. Peak does comply
per Paul Sakora 8/5/97 nww

SECTION I

Introduction and Specifications

1.1 THE MANUAL

This manual contains all relevant information for the operation, maintenance, and repair of the CPR-25 Interference Analyzer.

1.2 THE CPR-25

The CPR-25 Interference Analyzer is designed to measure electromagnetic interference (EMI) to the requirements and specifications set forth in FCC DOCKET 20780. In addition to the FCC requirements, the CPR-25 electrical characteristics comply fully to the specifications for EMI measurements as per CISPR (Comite International Special des Perturbations Radio electriques) publications 1-4 plus related VDE (Verband Deutscher Elektrotechniker) requirements and for quasi-peak measurements as per STANDARD C63.2-1980 of the American National Standards Institute (ANSI). In addition to the CISPR-mandated quasi-peak detection characteristics, the CPR-25 incorporates circuits for detecting the peak, average (carrier), or RMS levels of an input signal plus a circuit which determines the quotient of the RMS level as divided by either the average, peak, or quasi-peak levels.

The instrument covers the above specifications over a frequency range of 10KHz to 1GHz and utilizes a LCD readout to indicate the tuned frequency of the unit. Another LCD readout is utilized to indicate the total attenuation level of the unit and in addition has a provision for indicating unit overload. The frequency tuning, frequency range, RF & IF attenuation, venier gain (CAL.), detector functions & outputs, and impulse generator operation can be externally programmed, which permits the instrument to be integrated into either a computer/calculator or programmer control EMI system. Outputs are provided for the AM & FM video, audio, IF (1.6MHz), frequency display, antenna control, and to drive an X-Y recorder. In addition to these outputs; the horizontal, vertical, and blanking outputs for an external oscilloscope are provided which allow the video response of each octave range band to be presented on a conventional or storage-type oscilloscope.

1.3 UNPACKING

1.3.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform the manufacturer and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

1.3.2 Check contents of the carton against the shipping slip to be sure that all components and accessory items ordered are present. Notify the manufacturer immediately of any missing items.

1.4 ELECTRONIC SHIPPING DAMAGE

Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore, to check the operation of the instrument as soon as possible after unpacking.

To do so, perform the calibration tests outlined in paragraph 3.8.2. If the instrument does not perform as per these instructions, inform the Electro-Metrics Customer Service Department (518) 843-2600, giving the information required in paragraph 1.3.1.

1.5 INSTALLATION

1.5.1 The CPR-25 is designed for bench-top operation, field-portable operation, or for installation in a conventional 19-inch equipment rack.

1.5.2 Rack mounting requires the use of two adapter mounting brackets (ABM-25C). When utilizing these brackets, install the instrument by the following procedure:

a. Remove the four plastic feet.

b. With six 3/8 inch No. 10-32 screws, fasten the brackets to each side of the instrument at the matching screw holes.

c. Before installing the unit in the equipment rack, provide sufficient underneath support to carry the weight of the instrument (approx. 85 lbs.).

Optional slide mounts are also available for rack mounting the instrument and have the following advantages:

a. Facilitates removal of the unit from the rack for either servicing or field use.

b. Provides improved longitudinal support for the instrument.

1.6 ELECTRICAL SPECIFICATIONS

1.6.1 FREQUENCY RANGE

The useable frequency range extends from 10kHz to 1GHz in 15 bands. Each band provides a minimum of two percent overlap at each end with respect to adjacent bands.

1.6.2 FREQUENCY INDICATOR

Six Digit Liquid Crystal Display Readout.

1.6.2.1 FREQUENCY ACCURACY

Frequency accuracy is ±0.1% of the indicated tuned frequency over the entire 10kHz to 1000MHz range of the CPR-25.

1.6.3 FREQUENCY CONTROL

The analyzer is tunable over any single band by means of a front panel control or remotely by a variable voltage through the rear panel remote connector.

Frequency bands are switched by a dual front panel pushbutton control or remotely through the rear panel remote connector. Band indication to the remote locations is accomplished by BCD output logic.

1.6.4 INPUT IMPEDANCE

Input impedance is a nominal 50 ohms.

1.6.5 VOLTAGE ACCURACY

The voltage accuracy of the unit, as referenced against the internal calibrator, is ±2.0dB measured on the linear scale.

1.6.6 VOLTAGE RANGE

The CPR-25 is capable of measuring input signal levels over a range of .03uV to 1.0VRMS. The overall front panel meter range is 80dB (LOG SCALE), with the input attenuation range 80dB in 10dB steps (70dB RF and 10dB IF).

The input attenuation is activated by push buttons with a Liquid Crystal Display readout indicating the amount of attenuation (in dB) to be added to the meter reading. An overload condition is indicated by a blinking display.

1.6.7 SENSITIVITY/BANDWIDTH

Table 1-1 shows the sensitivity and bandwidths of the CPR-25 Interference Analyzer.

1.6.8 SPURIOUS REJECTION

Rejection to Image, IF, and other spurious frequencies typically exceeds 60dB and is never worse than 45dB throughout the entire 10kHz to 1000MHz range.

1.6.9 DETECTOR FUNCTIONS

TABLE 1-1

Sensitivity and Bandwidth

RF Band	Frequency Range	Bandwidths @ (-6dB)	Sensitivity (uV) (S+N/N=3dB)
1	10-35 kHz	200Hz	.03
2	35-75 kHz	200Hz	.03
3	70-150 kHz	200Hz	.03
4	150-250 kHz	9kHz	0.2
5	250-500 kHz	9kHz	0.2
6	0.5-1.1 MHz	9kHz	0.2
7	1.1-2.4 MHz	9kHz	0.2
8	2.4-5.5 MKz	9kHz	0.2
9	5.5-12.5 MHz	9kHz	0.2
10	12.5-30.0 MHz	9kHz	0.2
11	25-50 MHz	120kHz	0.6
12	50-100 MHz	120kHz	0.8
13	100-200 MHz	120kHz	0.8
14	200-500 MHz	120kHz	1.0
15	500-1000 MHz	120kHz	1.6

1.6.9.1 PEAK

A true peak-response of a calibrated RMS equivalent signal. The Automatic Dump circuit has a 1.0 second hold time, charge time of 1 usec and a discharge time > 10 seconds.

1.6.9.2 QUASI-PEAK

True CISPR quasi-peak time constants and bandwidth. See Table 1-2.

1.6.9.3 CARRIER

Produces an average value of the detected envelope with a nominal 600 msec charge and discharge time.

1.6.9.4 RMS

Produces a true RMS value of the detected video envelope with a nominal 600 msec charge and discharge time.

TABLE 1-2

CISPR Time Constants and Bandwidths

CISPR Characteristic	10kHz–150kHz	150kHz–30MHz	25MHz-1000MHz
Bandwidth at (-6dB)	200Hz	9kHz	120kHz
Electrical Charge Time Constant of QP Voltmeter	45MS	1MS	1MS
Electrical Discharge Time, Constant of Qp Voltmeter	500MS	160MS	550MS
Mechanical Time Constant of Critically- Damped Meter	160MS	160MS	100MS
Pre-detection Overload Factor (min.)	24dB	30dB	43.5dB
Post-detection Overload Factor (min.)	12dB	12dB	6dB

All electrical characteristics, including the above, are designed to comply fully to CISPR Publications 1-4 and all related VDE requirements, as well as ANSI C63.2-1980.

1.6.9.5 RMS/E

The quotient of the true RMS level divided by either the average (V_d), peak (V_p), or quasi-peak (V_{qp}) levels.

1.6.9.6 SLIDEBACK

A metered indication of "Threshold" bias for aural extinction of peak levels.

1.6.10 OUTPUTS

1.6.10.1 IF Output: 1.6MHz output at 1.5mV rms nominal into 50 ohms.

1.6.10.2 AM Video: 50mV Peak nominal into 50 ohms. FM Video: 50mV Peak nominal into 91 ohms.

1.6.10.3 Audio: 100mV nominal into 600 ohms.

1.6.10.4 X-Y Plotting: Single and dual pen capability.

X-Axis: 0 to 1.5 VDC nominal into 100K ohm load, scan time variable from 10 seconds to 1000 seconds.

Y-Axis: 0 to 1.5 VDC nominal into 100K ohm load.

PEN #1: Plots the function selected by the combination of the detector's function and output switches.

PEN #2: Plots either RMS, AVERAGE or PEAK depending on the PEN #2 switch position.

1.6.10.5 OSCILLOSCOPE OUTPUTS

Three outputs which supply the horizontal, vertical, and blanking inputs to a conventional or storage-type oscilloscope to produce spectrum-analyzer type displays of the CPR-25 bands.

1.6.11 CALIBRATION

The instrument includes a built-in calibration system utilizing an impulse generator. The impulse generator frequency range is 10kHz to 1000MHz at a nominal 100Hz repetition rate. It is activated as a transfer standard by the front panel "CAL" pushbutton.

1.6.12 POWER REQUIREMENTS

105-130VAC or 210-260VAC at 50-60Hz or 350-450Hz. An optional internal rechargeable battery is also available.

1.7 MECHANICAL CONSTRUCTION

The CPR-25 is divided into four major compartments. Lower, Upper, Front Panel/Control Section, and Power Supply. The main frame of the unit is constructed from self-aligning bars which are screwed together. Next a formed metal chassis is fastened to a frame which divides the frame into the upper and lower compartments. A front bulkhead divides these compartments from the Front Panel/Control Section. The Power Supply is fastened with screws, to the right rear of the Upper compartment. The remaining assemblies are fastened to the chassis with either machine screws or by quarter-turn fasteners to permanently welded fixtures. The front panel, side panels, and covers are fastened to the frame using machine screws.

SECTION II
Theory of Operation

2.0 INTRODUCTION

The theory of operation is divided into two parts. The first part is a general discussion concerning the various design considerations for the CPR-25; while the second part follows the signal flow path through the unit with a limited explanation of each module/section function and operation.

2.1 DESIGN AND OPERATIONAL CONSIDERATIONS

The design of the CPR-25 receiver is determined by the need to conform to the bandwidth, linear detection, overload, and detector requirements set forth in CISPR Publications 1-4 and related VDE, ANSI, and FCC requirements and specifications.

2.1.1 PRE-DETECTOR GAIN CONSIDERATIONS

For the question of Pre-Detector gain the following must be considered: the upper frequency range (25MHz to 1000MHz) requires a 120kHz bandwidth, while the lowest frequency range (10kHz to 150kHz) requires a 220Hz bandwidth. The narrower bandwidth of 220Hz results in an increased CW sensitivity which is almost 30dB higher than the CW sensitivity for the wider bandwidth of 120kHz. This in turn means that the receiver noise is almost 30dB higher for the upper frequency range as compared to the lower frequency range. Thus, if we make the gain in front of the Linear Detector equal for both frequency ranges the following would occur: for the upper frequency range the Linear Detector's greater than 60dB dynamic range would only be usable for about 30dB for the total range available. This is due to the fact that the lower 30dB of dynamic range would consist of receiver noise. Therefore, in order to have approximately 60dB of dynamic range for the entire frequency range of the CPR-25, the Pre-Detector Gain varies according to the frequency range/bandwidth being utilized.

2.1.2 AMPLITUDE DISPLAY CONSIDERATIONS

The difference in Pre-Detector Gain for the various frequency ranges must be taken into account in determining amplitude accuracy. In the Linear mode of the Detector Output switch, where the Linear meter scale covers only a range of 20dB, an offset is automatically added to the LCD Attenuator Display as each different frequency range is activated. In the LOG mode of the Detector Output switch, this method is not utilized since the effective 60dB range logged output for the meter is also used for X-Y plots. Thus a change in the effective attenuation setting for each different frequency range would make it difficult to interpret and correlate the different X-Y plots. Thus for this reason, in the Log mode of the Output switch, the logged outputs to the meter and the Y outputs are offset according to each individual frequency band segment used.

When a narrow width pulse is applied through a band-pass filter the output will appear as a bell shaped (Gaussian) ringing having the frequency of the tuned filter. The duration of the ringing is inversely proportional to the bandwidth of the filter. As an example: A short impulse passed through a receiver having a bandwidth of 9kHz will result, after envelope detection, in a bell shaped waveform having a 6dB down pulse width of 1/9HKz or approximately 100 usec. Since the charge time of the Quasi-Peak Detector for the upper frequency range is 1.0 msec, it can be seen that the Detector will charge only partially with each impulsive input. Thus it follows that the Detector output will vary depending upon the bandwidth which precedes it.

The basic unit for measuring the amplitude of an impulsive signal is Volt-Seconds (E•T). Since T=pulse width and 1/T=frequency, the amplitude of an impulsive signal may also be expressed as Volts/Hz (E/BW). The most common form of this relationship is uV/MHz (micro-Volts per Megahertz). When an impulse is passed through a lossless band-pass filter the relationship of E•T=E/BW is unaltered. Therefore, as the bandwidth of the filter is increased, the output voltage will also increase to maintain the ratio. Thus 1.0 uV/MHZ signal through a 100kHz filter will result in a peak output voltage of 1.0 uV/MHz=X/100kHz. Solving for x=.01/uV which is equivalent to -20dBuV. If the filter was 10MHz wide, 1.0uV/MHz=X/10MHz; solving for X=10uV which is equivalent to +20dBuV. The response of a lossless filter to a CW signal in the center of its band-pass is unity gain.

In summary:

Input Level (dBuV/MHz) • Bw(MHz) = Peak Output Level (uV)

which expressed in dB becomes:

Input Level (dBuV/MHz) + 20 Log BW(MHz) = Peak out (dBuV).

The term 20 Log BW(MHz) is known as the Broadband Correction Factor. When it is added to a measured peak level of a signal (dBuV), it results in the Impulsive Input Level (dBuV/MHz). When it is subtracted from a known input level (in dBuV/MHz) it will result in an equivalent CW input. Section 3.8.2.2-C shows the required Broadband Conversion Factors for the CPR-25.

From the preceding discussion it can be seen that knowing the receiver's bandpass is necessary for making broadband peak measurements. Also specifying an exact bandpass is necessary for a meaningful Quasi-Peak System.

2.1.3 CISPR QUASI-PEAK DETECTOR REQUIREMENTS

Section 1.6.9 (including Table 1-2) shows the Bandwidth and Detector characteristics required by the CISPR specifications and the corresponding Average and Peak Detector charge and discharge times. Due to the Quasi-Peak Detector's relatively long charge times plus relatively short decay times compared to the Peak Detector, its output level will be lower than the Peak level for isolated and low repetition rate impulsive inputs. In the case of an isolated impulsive input, the Quasi-Peak response can be as much as 43dB lower than the Peak response for the upper frequency ranges (25-1000MHz). As the repetition rate of the impulsive input is increased, the output level of the Quasi-Peak Detector will also increase. This is due to the fact that the Quasi-Peak Detector's charge time is much shorter than its discharge time and the charge is accumulative. At a high repetition rate, the Quasi-Peak output level will approach the Peak Detector output level.

Compared to the Carrier (Average) Detector, the non-symmetrical integration of the Quasi-Peak Detector provides a much more sensitive response to an impulsive input than does the symmetrical integration of the Carrier Detector. Quasi-Peak detection is utilized for the following reasons:

a. Unlike Peak detection, the repetition rate as well as the amplitude of an interfering source affects the readings.
b. Unlike Carrier (Average) detection, a low repetition impulsive input will result in a meaningful reading.

Peak, Carrier, and Quasi-Peak Detectors all respond the same to an unmodulated CW signal but will respond differently to a modulated or impulsive signal.

2.1.4 CISPR OVERLOAD REQUIREMENTS

As stated above, the CISPR (Quasi-Peak Detector) response to a low repetition rate impulsive input may be as much as 43dB below that of the Peak Detector signal level. This implies that an impulsive input signal may be overloading the preceding receiver stages, while only showing a low output level on the meter. This can be avoided if the receiver has a 43dB overload safety factor built in, but such an overload factor would drastically limit the dynamic range of the system.

In the CPR-25 Receiver; simultaneous Peak and Quasi-Peak detection is used, with the Peak detected output operating as a threshold overload detector. This method greatly increases the usable dynamic range without the danger of inaccurate measurements due to receiver front end overloading.

2.1.5 RMS/E CONSIDERATIONS

The CPR-25 Receiver, in common with other EMI receivers, is calibrated in terms of the RMS equivalent of the Peak, Quasi-Peak, and Average (Carrier) levels. If this were not the case, a CW input signal would not read the same for the other settings of the Detector Function switch (true Average is about 3dB below RMS while true Peak is about 3dB above RMS). In the CPR-25, the RMS/E circuit consists of a log ratio circuit that subtracts the instantaneous log of a selected detector function from the log of the equivalent RMS signal level. For an unmodulated CW signal, this difference is always zero (0) regardless of the detector function selected, since in this case all the different detector output levels are equal. For a modulated CW impulsive input signal however, each Detector output level will be different, with the front panel meter thus reading the instantaneous difference. Because different applications require varying integration times, a front panel time constant switch is utilized to select either a 0.6 second, 5.0 second, or 20 second time constant. The 0.6 second time constant allows a relatively Short-term integration of the compared signals, while the 20 second time constant allows a longer term integration. For RMS/Carrier, the time constants refer to both the charge and discharge times. For RMS/Peak, the times refer only to the discharge times, while for RMS/Quasi-Peak (CISPR) the times refer to the discharge time while the charge time is made proportionally longer.

The following discussions may help in understanding the value and limitations of RMS/E readings:

Assume that a 100PPS impulsive signal is feed through a 10kHz bandpass filter to a detector circuit, at a level of 1mV peak.

As described earlier, the 10kHz bandwidth results in a pulse width of 1/10kHz = 0.1 millisec at the detector.

The period is 1/100Hz = 10Msec.

The peak output level (Ep) is given as 1.0mV.

The duty cycle (d) = pulse width/period = 0.1 msec/10 msec = 1/100 = .01.

The average signal = Ep • d = 1.0mv • .01 = .01mv.

The RMS signal =

$$\sqrt{(\text{Ep})^2 \bullet \text{d}} = \sqrt{(1\text{mv})^2 \bullet .01} = 0.1\text{mV}.$$

$$\text{From above PK/RMS} = \frac{1\text{mv}}{0.1\text{mv}} = 10/1 = +20\text{dB}$$

This relationship holds as long as the input is a pure impulse and the measurement is uninfluenced by noise.

$$\text{Duty cycle (d)} = \quad \text{Log-1}\ \frac{\dfrac{\text{PK or CARR (dB)}}{\text{RMS}}}{10}$$

$$\text{where d} = \frac{\text{Rep Rate}}{\text{BW}}$$

Unfortunately, receiver noise often influences the reading. The following calculations are similar to the ones performed above except that receiver noise is assumed to be a residual DC(En) level of 0.1mv (20dB below the Peak level of the impulses):

Peak level (Ep) = 1.1mv

AVE. = (Ep-En) • d + En = (1mv-0.1mv) .01mv + 0.1mv = 0.1mv

$$\text{RMS} = \sqrt{(\text{Ep-En})^2\ \text{d}} + \text{En} = \sqrt{(1\text{mv-}0.1\text{mv})^2 .01} + 0.1\text{mv} = 0.190\text{V}$$

$$\text{The new RMS/AVE} = \frac{0.19}{0.10} = +5.6\text{dB}$$

$$\text{RMS/Pk} \quad = \frac{0.19}{1.0} = -14.4\text{dB}$$

It should be noted that the receiver noise level, 20dB below the Peak level, has changed the RMS/AVE by 14.4dB but the RMS/Pk by only 5.6dB.

2.1.6 IMPULSE GENERATOR CIRCUIT REQUIREMENTS

The impulse Generator produces a very narrow-high amplitude pulse at a 100Hz repetition rate, which is utilized by the CPR-25 Receiver as a calibration standard.

The narrow square-topped consistent pulse width is obtained by discharging a fixed length of transmission line by means of a mercury-wetted relay. The total length of the transmission line is one inch which results in a pulse width of less than 500 psec. The transmission line is charged from a DC voltage source which is varied, depending upon the Pre-Selector turret band segment being utilized, up to 80VDC.

A narrow width impulse will contain uniform frequency components across a selected frequency spectrum providing its width is narrow compared to a quarter wavelength at the highest frequency of interest in the spectrum. The amplitude of the frequency spectrum measured in uV/MHz is determined by the product of its amplitude and pulse width. An impulse level described in uV seconds can be converted directly into an equivalent wide band amplitude (uV/MHz) simply by converting units as follows:

Thus 1.0 uVsec = 1 X 10^6uV usec, and since T = 1/f.

1 X 10^6uV usec = 1 X 10^6uV/MHz = +120dBuV/MHz.

For the example given earlier, an impulse having an amplitude of 80V and a pulse width of 500 psec:

80V • 500psec - 10^{-6} usec = 4000 X 10^{-6}V usec = 4000uV usec = 4000uV/MHz = 72dBuV/MHz.

The distribution of the frequency components in a frequency spectrum depends upon the repetition rate of the impulse. A repetition rate of 100Hz results in frequency components spaced 100Hz apart across the entire usable frequency range of the CPR-25 (10kHz to 1000MHz).

2.1.7 BANDWIDTH AND IF FREQUENCY CONSIDERATIONS

The bandwidth responses for the CPR-25 are established by CISPR specifications and requirements and are as follows:

1. A 220Hz bandwidth for the frequency range 10kHz—150kHz (Band Segments 1-3).
2. A 9kHz bandwidth for the frequency range 150kHz—30MHz (Band Segments 4-10).
3. A 120 kHz bandwidth for the frequency range 25MHz—1000MHz (Band Segments 11-15).

These bandwidths are established within the CPR-25 receiver in the following manner:

1. The 220Hz bandwidth is set by a 220Hz crystal filter located within the Mixer Assembly of the CPR-25.
2. The 9kHz and 120kHz bandwidth are established within the two IF amplifier circuits of the CPR-25.

The CPR-25 is a superheterodyne receiver where the RF input signal is converted to an IF frequency for further amplification and band-pass shaping which for a CISPR receiver, having very tight band-pass requirements, is a necessity.

The RF amplifier for Band Segments 1-9 is located on the Stator board of the Pre-Selector Turret Assembly and is shared by the nine band segments. For Band Segments 10-15 the RF amplifier is incorporated on the individual band segments.

In Band Segments 1-10, the mixer for generating the first IF frequency is of the double-balanced active type and is located on the Stator board. The mixer's output feeds two different IF transformers and thus functions as a dual frequency mixer (175kHz and 1.6MHz). A double-balanced mixer, by canceling out the fundamental and harmonics of both the variable frequency oscillator and the RF input signal, provides improved rejection to RF and local oscillator products. The first IF mixer for Band Segments 11-15 is located on the individual band segment.

The local oscillator for Band Segments 1-10 is divided between the Stator board and the individual band segments: e.g. the coil and trimmers are on the band segment — active and varactor circuitry on the Stator. The output amplitude of the oscillator is stabilized by means of a closed-loop AGC circuit. An adjustable level control within the loop sets the amplitude level of the local oscillator. For Band Segments 11-15, the local oscillator circuit is located on the individual band segment.

The CPR-25 utilizes a total of six IF frequencies: 175kHz, 1.6MHz, 8.7MHz, 38.7MHz, 68.7MHz, and 98.7MHz. The 175kHz and 1.6MHz IF frequencies are utilized for Band Segments 1-10, with 175kHz used for Band Segments 1-3 (10kHz to 150kHz) and Band Segment 7 (1.1MHz to 2.4MHz) and 1.6MHz for Band Segments 4-6 (150kHz to 1.1MHz) and 8-10 (2.4MHz to 30MHz). The 175kHz IF frequency is utilized by Band Segments 1-3 because of the CISPR requirement of a 220Hz bandwidth for this frequency range and a crystal filter with a center frequency of 175kHz is the most practical way to accomplish it. The 175kHz IF frequency is also utilized by Band Segment 7 because the adjacent band segments use an IF frequency of 1.6MHz which lies within the frequency range for Band Segment 7. The 175kHz

IF frequency is converted, within the Mixer Assembly A5, to the 1.6MHz IF frequency utilized by Band Segments 4-6 and 8-10. The IF frequency of 1.6MHz for Band Segments 4-10 was chosen to be compatible with the CISPR requirement for bandpass gain, and Image Rejection for the frequency range covered by the band segments (150kHz to 30MHz). A second and final IF frequency of 8.7MHz is utilized by Band Segments 11-15 and is converted from the RF or first IF frequencies for these band segments in the Mixer Assembly A5. Again the 8.7MHz IF frequency was chosen to be compatible with the CISPR requirement for bandpass, gain, and Image Rejection for the frequency range covered by the band segments (25MHz to 1000MHz). The remaining three IF frequencies of 38.7MHz, 68.7MHz, and 98.7MHz are generated on the Band Segments 13, 14 and 15 respectively. These frequencies were chosen for ease in double converting the RF input to the final IF frequency of 8.7MHz. Double conversion is utilized for the three upper band segments to improve Image Rejection, IF Rejection, band segment sensitivity, and other band segment characteristics. Band Segments 11 and 12 amplified RF output and VFO output are mixed in the Mixer Assembly A5 to generate the 8.7MHz IF output.

2.1.8 ENVELOPE DETECTOR CONSIDERATIONS

The truly linear range of a simple diode detector is limited to about 30-40dB. This is because the lower-end linearity is distorted by the diode resistance, while the upper-end linearity is limited by attainable driving voltage. A carefully designed biased diode detector may have a usable dynamic range of 45-50dB. For the CPR-25 to conform to the CISPR overload requirements and have sufficient dynamic range, it is necessary to have a detector that is linear over a 60 to 70dB range.

To obtain the necessary dynamic range, the CPR-25 utilizes two diode detectors each operating at a different gain level. The low gain diode detector detects the higher level signals, while the high gain diode detector detects the lower level signal. The high gain detector has a diode limiter circuit on its output which provides a cross-over point for the two detectors. Since the source impedance of the diode limiter circuit is the same as the driving impedance of the low gain diode detector, the two diode drops will compliment each other and provide a smooth transient. The outputs of the two detector circuits are "ADDED" in an operational amplifier whose adding resistors are chosen to equalize the gain of the two detectors.

2.1.9 DETECTOR REQUIREMENTS AND CONSIDERATIONS

The following is a discussion of the significance and use of the five detector functions of the CPR-25 (CARRIER, RMS, QUASI-PEAK, PEAK, SLIDEBACK).

2.1.9.1 PEAK DETECTION

This detector mode measures the peak level of a video signal, either impulsive or CW, and implies a detector rise time fast enough to handle the fastest possible input signal. In the CPR-25 this rise time is approximately 1.0 usec in order to handle impulsive signals in the 120kHz IF bandpass, which has a rise time of 8.0 usec. In addition; the hold time must be of sufficient length, measured in seconds, to enable accurate peak level readings to be made without signal degradation. However, measurements would then become very time consuming since the operator would have to wait for the detector to discharge after each reading. Thus a detector dumping circuit is needed to prepare the receiver for its next reading. In the CPR-25 an automatic Dump/Hold circuit is utilized, which instantaneously senses an increasing signal level. After two seconds if a higher signal level is not sensed, the detector charge is dumped. It remains in the dumping mode until another increasing signal level is detected, which again turns the dumping circuit off for two seconds.

2.1.9.2 SLIDEBACK DETECTION

This is a modified means of making peak measurements that is useful in determining the peak level of a signal that is masked by noise or another impulsive signal.

It consists of a DC biased threshold detector whose DC limit is adjustable by means of the front panel Slideback Control. The detector will pass only that part of the input signal that exceeds the slideback bias limit. The Audio Amplifier system is switched to the output of the detector diode, so that the audio signal heard in the earphones is equivalent to that portion of the video signal that exceeds the DC bias slideback level. When the slideback control is adjusted to just extinguish the audio level of the signal of interest on the earphones, the resultant DC bias level will be equal to the peak of the signal level being measured. The front panel meter is utilized to read the DC bias level, with suitable attenuator and other factors added, in dBuV. This detector system/method allows the peak level of the video signal to be determined even if it is lower in level than other background interference.

2.1.9.3 CARRIER DETECTION

A symmetrical integrating circuit with equal charge and discharge times (600 msec typical) which averages the video signal. By stripping a modulated signal of its modulation, the carrier level of the signal is determined. This mode of detection is not of much value for measuring low duty or impulsive. signals except in the RMS/ Carrier output function to be described later.

2.1.9.4 TRUE RMS DETECTION

Produces an indication of the average power of the video signal. Instantaneous power levels are summed, the resulting output is the average power represented by a DC voltage. The equation for the output voltage is:

$$E_o = \sqrt{{}_{To}^{Ti}\; e^2dT}$$

The normal averaging time constant is 600msec. This detector is the reference for making RMS/E measurements. For the RMS/E mode the time constant is front panel selectable (0.6,5, or 20 seconds).

2.1.10 QUASI-PEAK DETECTION

This form of detection is intended to determine the overall effects of various forms of interference upon communications reliability. As noted in section 2.1.3, it requires a short but well defined rise time, a relatively long and well defined decay time, and a closely controlled receiver bandwidth. In addition, unlike Carrier or RMS detection, the relatively short time constants makes the detector useful for making low duty cycle signal measurements. However, unlike Peak detection, the output level will change depending upon the duty cycle of the video input signal. Plus, since compared to Peak, the decay time is short a dump circuit is not required. The above conditions makes this detector function the easiest to use for normal receiver tuning.

2.2 CPR-25 OPERATION AND FUNCTION

This part of the Theory of Operation explains in detail the operation of the various sections, subsections, modules, and submodules of the CPR-25. For the following discussion, utilization of the CPR-25 schematics in Section VI will be useful in understanding the CPR-25 signal flow path plus the function and operation of individual section/modules.

2.2.1 RF INPUT/RF ATTENUATOR CIRCUIT

The RF Input connector, which is mounted on the lower right hand corner of the front panel, is combined with a low-pass filter A1A2 having a cutoff frequency of 1.0 GHz. Its function is to limit the broadband input spectrum to prevent receiver overload and to improve Image Rejection at the higher tuned frequencies. After the filter the signal is transmitted via rigid coaxial cables through the front bulkhead to an RF Attenuator A2A18 mounted on the Pre Selector turret assembly A2.

The attenuator's frequency response is essentially flat over the frequency range of 10 kHz to 1.0 GHz and covers a 70dB attenuator range in 10dB steps. The attenuator consists of three separate internal attenuators having values of 10dB, 20dB, and 40dB pf attenuation respectively, which are electromechanically switched into the circuit in series. Since each internal attenuator must be either selected or not selected, a total of six control lines consisting of 10dB, $\overline{10}$dB, 20dB, $\overline{20}$dB, 40dB, or $\overline{40}$dB are required. The attenuator drive level (24Vdc @ 110ma) is obtained from the Attenuator Drive board (A2A19), which is mounted to the Pre-Selector turret assembly near the attenuator mount, via a multi-pin connector and cable. The Attenuator Drive board converts the three input CMOS(+12V) logic from the Attenuator B board (A7A1A9), located in the lower compartment, to the six output +24VDC high current logic signals required by the attenuator. The Attenuator B board is described later in Section 2.2.11.2.

2.2.2 IMPULSE GENERATOR CIRCUIT

The output of the RF Attenuator is fed via a rigid coaxial cable to connector A2A17-J1 of the Impulse Generator A2A17. The Impulse Generator, which is mounted (externally) on the end plate of the Pre-Selector Turret Assembly A2, is utilized as a transfer standard for the amplitude calibration of the CPR-25 Receiver.

In the base of the Impulse Generator assembly is a subminiature relay which switches the I.G. Output connector A2A17-J2 between the RF input signal and the output of the I.G. circuit. For the normal mode of CPR-25 operation (e.g. as a receiver), the RF input signal passes through the normally closed contacts of the relay to the output connector A2A17-J2. When the I.G. circuitry is activated by a logic command (initiated by the front panel "CAL" switch) it also activates the relay which then shorts the RF input to ground and places the I.G. circuit impulsive output onto the output connector of the I.G. assembly. The "impulse generator" circuit comprises a coil, driven by a 100Hz multi-vibrator circuit mounted coaxially around a charging line. The charging line consists of a mercury wetted relay, an inch-long transmission line, plus a large charging resistor connected to a DC voltage source. The DC voltage source charges the charging line to a level, determined by the band segment being utilized by the RF Pre-Selector, that can be as high as 80VDC. When the mercury-wetted relay is closed, the charging line is discharged into a 50ohm line. A 6dB attenuator at the output of the mercury switch insures a good source/load impedance match and reduces the possibility of standing waves. The resulting impulsive output is then sent via the RF/IG switching relay to the I.G. Output connector A2A17-J2.

The output of the Impulse Generator, either the RF input signal or the impulsive output, is sent via a rigid coaxial cable to the RF input (A2J6) of the Pre-Selector turret assembly A2.

2.2.3 PRE-SELECTOR TURRET ASSEMBLY A2

The Pre-Selector A2 utilizes fifteen band segments to cover the frequency range of 10kHz to 1GHz. A motor-driven mechanism is used to rotate each band segment into position against a series of thirty nickel-plated spring contacts. The contacts are part of the Stator board assembly which performs the following functions:

a. For Band Segments 1-10: provides all the active circuits, varactors/varactor control circuitry, and all electrical connections.

b. For Band Segments 11-15: provides the input/output connections plus all operating and tuning voltages to the bandstrip segments.

During the course of the following discussion, the Stator board will be referred to several times in greater detail as part of the Pre-Selector operation and function.

The Pre-Selector Assembly performs all or part of the following functions:

a. RF tuning. Three varactor tuned RF filters are used in each band segment to provide Image and Spurious Signal Response rejection and to prevent saturation of the RF amplifier/mixer circuits caused by Broadband Interference signals. As noted earlier, the Impulse Generator can produce an impulse with an amplitude of 80V. This great an impulsive input would instantly saturate the RF amplifier were it not for the tuned band-pass RF filter. The use of varactor tuning permits the use of remote tuning for automated systems and allows fast tuning for spectrum analyzer-type CRT displays. The varactors for Band Segments 1-10 are mounted on the Stator board and used in common for each band segment. For Band Segments 11-15, however, the tuning varactors are contained within each individual band segment.

b. RF Amplification. To improve the receiver sensitivity, the RF input signal is amplified at the RF frequency in a low noise amplifier before being converted to a selected IF frequency in a relatively noisy mixer.

In Band Segments 1-10, the Stator board contains a double-balanced mixer whose common output is coupled through diodes to two separate IF transformers. One IF transformer is tuned to 175kHz, with the second IF transformer tuned to 1.6MHz. The operating voltage for the mixer is applied through the selected IF transformer and blocking diode via selected jumper wires located in each bandstrip segment. The unused IF transformer will not affect circuit operation, since its coupling diode will be backbiased. The outputs of the IF transformers are coupled via coaxial cables to the respective inputs on the Mixer Assembly A5.

For Band Segments 11-15, the mixer circuitry will be described in the individual bandstrip segment discussions and in the discussion for the Mixer Assembly (A5).

2.2.3.1 TURRET BANDSTRIP SEGMENTS

2.2.3.1.1 BAND SEGMENTS 1, 2, 3 & 7

These Bandstrip segments will be discussed as a group, since their modes of operation are similar.

The RF input transformer is a tuned coil located on each band segment – the primary to secondary turns ratio is selected to provide a 50 ohm input impedance, while the secondary's inductance is selected to be resonant with the Stator board varactors over the required frequency range. The coil slug is adjusted for RF tracking at the low end of the frequency band, while a trimmer capacitor across the secondary is adjusted for RF tracking at the high end of the frequency band.

Each set of varactors on the Stator board consists of a series-parallel combinations of four varactors. The series connected back to back varactors provide low-end stability, since at the low frequency end of band segment, the varactor tuning voltage is very low (0.2V). Thus a small change in the tuning voltage will cause a large change in the value of the varactor's capacitance. Therefore, a high amplitude RF signal could pump the varactors, causing varactor detuning. Connecting two varactors back to back in series will prevent this since a decreasing AC voltage on one varactor will result in an increasing AC voltage on the second varactor. For Band Segments, 1, 2, 3 & 7, a second pair of series connected varactors is connected in parallel with the first pair. This is done to provide increased capacitance needed for RF tuning at the lower frequencies. The varactor anodes are connected through isolation resistors and temperature compensating diodes to the HV tuning line. In addition the anodes are also connected through isolation resistors to a slightly negative bias voltage produced by a voltage divider from the -6VDC line. The resistor values of the voltage divider network are factory selected to compensate for the low voltage differences among the varactor packs.

2.2.3.1.2 RF AMPLIFIER – BAND SEGMENTS 1-9

The RF amplifier, which is common for Band Segments 1-9, is of the cascade type consisting of a gate driven FET which in turn drives a grounded base amplifier. The characteristics of this amplifier circuit are high input impedance, high gain, and good gain stability over a wide frequency range. The output of the RF amplifier consists of a double-tuned end coupled resonant circuit, having the coils and coupling networks on the individual bandstrip segment with the varactor tuning networks for both resonant circuits located on the Stator board. Both of the resonant circuits are tuned in the same manner as the input stage (e.g. coil slugs for low end and trimmer capacitors for upper end of band segment). The gain of the RF amplifier stage is approximately 50dB. The final gain of each band segment is factory adjusted by means of a voltage divider network on the output of the second interstage coil. The second interstage output feeds a boot-strapped unity gain FET follower which provides impedance matching between the high impedance resonant circuit and the 50 ohm input to the balanced mixer. The microcircuit balanced mixer is essentially four differentially paired transistors, whose series/parallel input/output connections are such that cancellation of the output currents occur for each input (RF and local oscillator) while their product currents are additive. Two balance controls, one for the RF input and the other for the local oscillator input, allow the optimum rejection to be obtained.

2.2.3.1.3 LOCAL OSCILLATOR BAND SEGMENTS 1, 2, 3 & 7

The IF frequency for Band Segments 1, 2, 3 & 7 is 175kHz; therefore, the local oscillator must generate a signal which is always 175kHz above the tuned RF frequency. The coil for the local oscillator circuit, which is basically of the Hartly design, is located on the band segment while the active and varactor circuitry is located on the Stator board. An automatic gain control circuit compares an adjustable DC voltage with the peak level of the oscillator output and varies the emitter drive of the oscillator to maintain a constant level out across each band segment and from band segment to band segment. The circuit, in common with the circuits described above, has the usual coil slug adjustment plus trimmer capacitor and in addition also has an adjustable padder capacitor in series with the varactor circuitry to facilitate frequency tracking.

The IF frequency of 175kHz was chosen for Band Segments 1, 2, & 3 because these bandstrips cover the frequency range of 10kHz to 150kHz. This frequency range has a CISPR bandwidth requirement of 220Hz, which is easily obtainable with a crystal filter at a center frequency of 175kHz. Band Segment 7 (1.1MHz to 2.4MHz) utilizes the 175kHz 1st IF frequency since 1.6MHz which lies within the frequency range for Band Segment 7 is one of the IF frequencies used by the CPR-25.

2.2.3.1.4 BAND SEGMENTS 4, 5, 6, 8 & 9

The RF amplifier, Local Oscillator, and mixer circuits for these band segments operate on the same principle as for Band Segments 1, 2, 3 & 7. The main difference is that these band segments utilize a 1.6MHz output IF frequency. This IF frequency was chosen to be compatible with the CISPR requirements for bandpass, gain, and Image Rejection at the frequency ranges covered by the band segments (150kHz to 12MHz). The Local Oscillator generates a signal which is 1.6MHz above the tuned RF frequency. Selected jumper wires in the band segments activate the 1.6MHz IF output transformer and thus the balanced mixer.

2.2.3.1.5 BAND SEGMENT 10

Due to the higher frequency range of the band segment (12MHz to 30MHz), all the RF amplifier circuitry is located on the band segment. However, the local oscillator and balanced mixer located on the Stator board are still utilized for this band segment as they were for Band Segments 1-9 and use the same IF frequency of 1.6MHz.

The RF amplifier comprises two transistor input cascade amplifiers with varactor tuned filters at the following:

a. The RF Input.
b. Between the RF amplifiers.
c. At the RF Output.

Each of the tuned circuits consists of an adjustable coil, a trimmer capacitor, and a varactor package. The HV tuning voltage from the Stator board is utilized in tuning the band segments varactors.

2.2.3.1.6 BAND SEGMENTS 11 & 12

These two band segments together cover the frequency range of 25MHz to 100MHz and due to these higher frequencies, all the RF amplifier and local oscillator circuitry is located on the band segments. As in Band Segment 10, these two band segments utilize two transistor input cascade amplifiers plus three varactor-tuned RF filters. The amplified RF signal is sent via the Stator contacts and a coaxial cable to the Mixer Assembly A5. The local oscillator is modified Hartly, whose output is coupled via the Stator contacts and a coaxial cable to the Mixer Assembly. The local oscillator generates a signal which is 8.7MHz above the tuned RF signal input. The local oscillator signal and the amplified RF signal are mixed in the A5 Mixer Assembly to produce the 1st IF frequency of 8.7MHz. The HV tuning voltage from the Stator board is applied via the stator contacts to tune the band segments varactors. The frequency tracking is accomplished as in other band segments by coil adjustments and trimmer capacitors.

2.2.3.1.7 BAND SEGMENT 13

The Band Segment 13 has the RF amplifiers, variable frequency oscillator, first IF mixer, and first IF amplifier contained within the bandstrip itself. The band segment covers a frequency range 100MHz to 200MHz. Because of the higher frequency range, the band segment is double converted in order to obtain sufficient Image Rejection. The first IF frequency is 38.7MHz with a second IF frequency of 8.7MHz being generated in the A5 Mixer Assembly. The RF amplification utilizes two RF amplifiers and three varactor-tuned RF filter circuits. The local oscillator is a varactor-tuned modified Colpitts design that generates a signal which is 38.7MHz above the tuned RF input signal. A double-balanced mixer, comprised of discrete components, mixes the tuned RF signal and the local oscillator signal to produce the first IF frequency of 38.7MHz. This is followed by a single-stage 38.7MHz IF amplifer having two flat-tuned filters. The 38.7 IF output signal is then fed to the A5 Mixer Assembly via the same stator contacts and coaxial cable used for the RF output for Band Segments 11 & 12.

2.2.3.1.8 BAND SEGMENT 14

The operation of this band segment which covers the frequency range of 200MHz to 500MHz is similar to Band Segment 13. The major differences are:

a. The local oscillator operates 68.7MHz above the tuned RF signal input.
b. The first IF frequency is 68.7MHz.
c. The Mixer circuit is not balanced.

2.2.3.1.9 BAND SEGMENT 15

The operation and function of this band segment, which covers the frequency range of 500MHz to 1000MHz, is very similar to Band Segments 13 & 14. However, because of the higher frequency range, the band segment utilizes patented varactor-tuned strip line RF filters in place of the usual RF filters of the other bands. The RF amplification utilizes three of the strip line RF filters plus two RF amplifiers, with the first RF amplifier being of the cascade configuration and the second being a common emitter amplifier. The local oscillator is a varactor-tuned modified Hartly design that generates a signal which is 98.7MHz above the tuned RF signal input. An unbalanced active discrete component mixer mixes the amplified RF signal and the local oscillator signal to produce the first IF frequency of 98.7MHz. This is followed by a single-stage double-tuned 98.7MHz IF amplifier. The 98.7MHz IF output signal is then fed to the A5 Mixer Assembly via the same stator contacts and coaxial cable as utilized by Band Segments 13 & 14. The high IF frequency was selected to provide greater Image Frequency Rejection. A varactor-tuned image trap at the RF input filter is also utilized to improve the Image Rejection.

2.2.4 MIXER ASSEMBLY A5

The Mixer Assembly (A5) is a shielded assembly located in the upper compartment of the CPR-25 near the Pre-Selector Turret Assembly. The Mixer functions as an interface between the Pre-Selector Turret Assembly A2 and the IF Amplifier Assembly A3. It accepts the various IF/RF/Oscillator outputs from the Pre-Selector Turret Assembly and performs the following functions:

a. Adjustments of gain levels.

b. In the case of Band Segments 1-3, shaping the bandpass.

c. Mixing the different inputs to produce the required 1.6MHz and 8.7MHz final IF frequency outputs and levels.

The logic command and control signals for the Mixer are received from the Pre-Selector Turret Assembly and the IF/Mixer Control P.C. board (A6A2). In the following discussion the Mixer will be separated into three functional blocks:

a. 175kHz IF Processing.

b. 1.6MHz IF Processing.

c. Band Segments 11-15 Signal Processing.

2.2.4.1 175kHz IF PROCESSING

For Band Segments 1, 2, 3 & 7 the IF frequency from the Pre-Selector is 175kHz. As was noted before, the 175kHz frequency was selected due to the CISPR requirement for a 220Hz bandpass response in the frequency range covered by Band Segments 1-3 (10kHz to 150kHz). A 220Hz crystal filter with a center frequency of 175kHz was chosen as the most practical way to meet this requirement. In the case of Band Segment 7, with a frequency range of 1.1MHz to 2.4MHz, the 175kHz IF frequency is utilized since the 1.6MHz IF frequency (utilized on the adjacent band segments) is within the frequency tuning range of the band segment. The 220Hz crystal filter, located on the Mixer Assembly PC board (A5A1), is switched into the circuit for Band Segments 1-3 by means of diode switches. When Band Segment 7 is being utilized, the crystal filter is switched out of the circuit and a level control circuit plus high pass filter is switched into the circuit. The diode switches which control these operations are activated by +12V logic levels from the Pre-Selector Turret Assembly and the band segments in question. The common output of the above circuit is fed to the base of a transistor mixer. The emitter of the transistor mixer is fed by a crystal controlled local oscillator having an output frequency of 1.425MHz. The sum of the local oscillator and the 175kHz IF frequency is the final IF frequency of 1.6MHz which is then passed through the tuned mixer output transformer to a diode switch. The mixer and local oscillator are activated by the logic for either Band Segments 1-3 or Band Segment 7. Because the system gain requirements are different for Band Segments 1-3 and Band Segment 7, the 1.6MHz IF output can be shunted through two different attenuators via a diode switch. One attenuator is switched in for Band Segments 1-3, with the remaining attenuator being utilized for Band Segment 7. The Band Segment 7 attenuator has a screw-driver adjustment to enable the gain of the band segment to be adjusted to match that of Band Segments 4-6 and 8-10. The common output for the two attenuators is fed to the 1.6MHz IF output. In summary, this circuit provides band-pass shaping for Band Segments 1-3, converts the 175kHz IF of Band Segments, 1, 2, 3 and 7 to 1.6MHz and provides a means of gain calibration for Band Segments 1-3 and 7.

2.2.4.2 1.6MHz IF PROCESSING

The only signal processing done to the 1.6MHz final IF frequency output of Band Segments 4-6 and 8-10 is as follows:

a. A screwdriver adjustment for gain control in the 1.6MHz IF channel.

b. Utilization of a diode switch to connect the 1.6MHz IF output from the Pre-Selector Turret Assembly to the 1.6MHz output to the IF Amplifer. A + 12V logic level signal from the Pre-Selector and the band segments being utilized is used to activate the diode switch.

2.2.4.3 BAND SEGMENTS 11-15 SIGNAL PROCESSING

This circuit comprises a transistor mixer, three separate crystal controlled local oscillator circuits, and the logic control inputs for the RF/IF signal inputs/local oscillator activation switching. The purpose of this circuit is process the various RF/IF output signals from the Pre-Selector Turret Assembly for Band Segments 11-15 and to develop a common 8.7MHz IF output.

2.2.4.3.1 BAND SEGMENTS 11-12 MIXER OPERATION

The amplified RF signal from the Pre-Selector Turret Assembly is applied via input connector A5J3 to the base of the mixer transistor. The local oscillator output from the band segments is applied via input connector A5J2 and through a diode switch to the emitter of the mixer transistor. A-6VDC logic signal from the IF/MIXER CONTROL board A6A2 controls the diode switch and also supplies the operating voltage for the mixer. The output transformer of the mixer is tuned to 8.7MHz and provides impedance matching between the higher impedance of the transistor mixer and the 50 ohm input impedance of the 8.7MHz IF Amplifer A3A2. The 8.7MHz IF output is connected via a coaxial cable between the mixer and IF Amplifer.

NOTE: In the following discussions for Band Segments 13, 14 and 15, the first IF output of these band segments is applied to the same input connector A5J3. The mixer and output transformer are the same ones used for Band Segments 11 & 12. The operation of the mixer is similar.

2.2.4.3.2 BAND SEGMENT 13

The 38.7MHz first IF output of the Band Segment is applied to the base of the mixer transistor. A -6VDC logic signal from the IF/MIXER CONTROL board A6A2 activates the mixer by means of a diode switch and a 30MHz crystal-controlled local oscillator. The 30MHz crystal frequency is applied to the emitter of the mixer transistor mixed with the 38.7MHz first IF signal, to produce the final 8.7MHz IF frequency output.

2.2.4.3.3 BAND SEGMENT 14

Operation is the same as for Band Segment 13 except for first IF signal input of 68.7MHz and a crystal controlled local oscillator output of 60MHz to produce the 8.7MHz final IF output signal.

2.2.4.3.4 BAND SEGMENT 15

Operation is the same as for Band Segments 13 & 14 except for first IF signal input of 98.7MHz and a crystal controlled local oscillator output of 90MHz to produce the 8.7MHz final IF output signal.

2.2.5 IF AMPLIFIER A3

The IF Assembly Module (A3) is a shielded assembly located in the upper compartment of the CPR-25 next to the Mixer Assembly (A5). The assembly is divided into three separate shielded sections as follows:

a. The 1.6MHz—9kHz bandwidth IF Amplifier Circuit.

b. The 8.7MHz—120kHz bandwidth IF Amplifier/converter circuit.

c. The IF Discriminator circuit which will be described separately in Section 2.2.7

The 1.6MHz—9kHz bandwidth IF Amplifier is utilized for Band Segments 1-10 (10kHz to 30MHz) and provides the required CISPR bandwidth response for Band Segments 4-10 (150kHz to 30MHz). The 8.7MHz—120kHz bandwidth IF Amplifier/Converter utilized for Band Segments 11-15 (25kHz to 1000MHz) provides the required CISPR bandwidth response for these band segments and contain a frequency converted circuit to produce the final IF output of 1.6MHz. The output of each IF circuit is connected to a common output which is fed via a coaxial cable to the Linear Detector Assembly (A4). A-6V logic signal from the IF/MIXER CONTROL board (A6A2) determines which IF Amplifier is activated and also supplies the negative supply voltage to the IF. In addition, each IF Amplifer contains an IF attenuator with FET switched steps of 0dB and

10dB with the 8.7MHz IF amplifier circuit containing an additional step of 20dB. The FET switches are controlled by logic signals from the Attenuator B board A7A1A9 located in the lower compartment of the CPR-25.

2.2.5.1 1.6MHz—9kHz BANDWIDTH IF AMPLIFIER

The amplifier consists of two similar circuits separated by the FET switched IF Attenuator. Each circuit section comprises a grounded-base input amplifier, two slightly overcoupled resonant circuits, and a boot-strapped source-follower output stage. The high-end capacitive coupling of the first section resonant circuits is by means of a trimmer capacitor, which by varying the coupling provides a means of bandwidth adjustment. In the second section the resonant circuits are inductively coupled through their common ground returns, which provides bandpass symmetry. The grounded base input and source follower output amplifier combination are utilized because of the following advantages:

a. Low (50 ohm) input impedance.

b. Low (50 ohm) output impedance.

c. High-Controllable resonant circuit input and output impedances.

d. High-Stable gain.

The gain of the IF Amplifier is set by a screwdriver adjustable potentiometer at the input of the first circuit section. Between the first and second circuit sections is located an IF attenuator which utilizes two FET switches to control the value of the input resistance to the second section. The necessary switching logic (-6V/OV) for the FET switches is obtained from the Attenuator B board. The IF MIXER CONTROL board (A6A2) activates the IF Amplifier by switching the -6VDC supply to the circuit.

2.2.5.2 8.7MHz—120kHz BANDWIDTH IF AMPLIFIER/CONVERTER

The theory of operation for the 8.7MHz—120kHz IF Amplifier is the same as for the 1.6MHz—9kHz IF Amplifier except for the following:

a. The input or first section is tuned to 8.7MHz.

b. The output or second section is tuned to 1.6MHz.

c. Between the two sections is a frequency converter in addition to the FET switched IF attenuator.

The converter comprises a crystal oscillator generating a frequency of 7.1MHz which is applied to the emitter of a mixer transistor, while the IF signal from the first section is applied to the base of the mixer transistor. The resultant 1.6MHz output of the mixer is fed to a transformer, tuned to 1.6MHz, and having a large step-down ratio to supply the second section with a 50 ohm source impedance. The FET-switched IF attenuator is of the ladder type and utilizes the same logic signals as does the similar FET switches for the 1.6MHz-9kHz IF attenuator. The gain for the IF Amplifier is set by a screwdriver adjustable potentiometer on the output of the first section.

2.2.6 LINEAR DETECTOR MODULE A4

The 1.6MHz IF output of the IF Amplifier Assembly (A3) is fed via a coaxial cable to the input (A4J1) of the Linear Detector Module (A4). The Linear Detector circuit is divided into four sections: Gain Control Amplifier circuit, Low Gain Detector driver, High Gain Detector driver, and Adder circuit.

The Gain Control Amplifier circuit comprises a TO-5 sized micro circuit consisting of a cascode drivers differential transistor pair. The variable gain control voltage is applied via a voltage divider network to the differential input, while the 1.6MHz IF signal is applied to the cascode input. The IF signal varies the total current through the device, while the gain control voltage determines the differential division of the IF signal. The variable DC gain control voltage is applied to the Detector module via a FET switch on the Detector Logic board A7A1A11 (located in the lower compartment) from the front panel CAL GAIN CONTROL. The variable gain control voltage input allows the amplifier gain to be varied over a range of 30dB permitting Amplitude calibration of the CPR-25 Receiver. The output of the Gain Control circuit is developed across a broad tuned resonant circuit on the differential output of the amplifier. The output of the Gain Control circuit utilizes an emitter follower buffer stage to feed two different detector driver circuits, a low gain and high gain circuit. The Low Gain Detector Driver detects the high level input signals, while the High Gain Detector Driver detects the low level input signals.

The Low Gain Detector Driver is comprised of two transistors in a totem pole configuration which functions as a unity gain, high level, low impedance driver. The output of the totem pole driver is coupled to a step up transformer whose secondary is tuned to 1.6MHz and which drives the high level envelope detector diode. This high level detected signal, which can be as high as 50VDC, is filtered and fed to the high level input of the Adder circuit.

The High Gain Detector Driver is similar to the Low Gain Detector Driver in that a totem pole transistor configuration is used to drive a low level envelope detector diode via a step up transformer. However, the gain of the amplifier is not set at unity but is controlled by an emitter feedback circuit, which uses a screwdriver adjustable potentiometer to vary the driver amplifier gain from 30 to 40dB. The gain adjustment also sets the crossover point of the two detectors and is used to obtain medium level detector linearity. The output of the Low Level Detector circuit is fed to the low level input of the Adder circuit via a relatively large gain equalization resistor and a grounded diode limiter. The diode limiter begins conduction at the same signal level that the High Level Detector Driver begins conductions. The low level envelope detector diode utilizes an adjustable bias level supplied by a biasing circuit. The biasing circuit comprises a unity gain FET input operational amplifier whose input circuit has the bias control voltage applied via a large value resistor. A screwdriver adjustable potentiometer varies the bias level and a diode to ground provides temperature compensation for the bias circuit. The low level envelope detector diode is slightly forward biased in order to obtain additional dynamic range from the detector. The total linear dynamic range to be expected from the two detector circuits is between 70 and 80dB. The outputs of the two detector circuits are fed to the input of the Adder circuit.

The Adder circuit is comprised of a FET input operational amplifier whose gain is less than unity. A screwdriver adjustable gain control sets the required detector output voltage, while a zero adjustment cancels out any DC offset. The envelope detected linear output of the Adder circuit (A4J4) is connected, via a coaxial cable, to the inputs of all three detector boards (PEAK, RMS, Q.P./CARR.) which are located in the lower compartment of the CPR-25.

Two additional outputs from the Linear Detector Module A4 are taken off the output of the Low Gain Detector Driver. One output (A4J2) is the 1.6MHz IF signal output to the rear panel IF Output connector (A7J10), while a second output (A4J3) is the IF output to the Discriminator input connector (A3J3) located on the IF Amplifier Assembly.

2.2.7 IF DISCRIMINATOR CIRCUIT (A3A3)

The IF Discriminator Circuit (A3A3), located in the IF Assembly Module (A3), receives the 1.6MHz high level IF signal from the Linear Detector Module (A4) via a coaxial cable to the Discriminator Input connector A3J3. The high level IF signal drives a two stage limiter/amplifier input circuit whose system gain is such that limiting will occur on receiver noise.

The output of second limiter stage is connected to the tap of a transformer tuned to 1.6MHz. The high level end of this tuned circuit is capacitively coupled to the discriminator circuit and constitutes the common mode input to a standard Foster-Seely Discriminator circuit. The secondary of the tuned transformer is link-coupled to the low impedance input of another tuned transformer whose secondary is connected to two discriminator diodes. A center tap from this tuned transformer's secondary winding is connected to the common mode signal input to the discriminator.

When a CW signal at the center frequency of 1.6MHz is applied to the circuit input, it will result in equal driving voltages to the two discriminator diodes since the common mode input is 90° out of phase with each transformer leg output. Since the diode load resistors are connected series opposing, the discriminator output is zero. A deviation in the input frequency in either direction from the 1.6MHz center frequency will result in a phase shifted signal when added to the unshifted common mode signal results in different driving voltages to each of the two discriminator diodes. This, in turn, produces unequal diode conduction which results in a discriminator output whose polarity is determined by the direction of the phase shift. The discriminator output is followed by a two section RC filter to further remove the IF frequency components from the video signal. The output of the filter is fed to a switched gain amplifier/low pass filter circuit, whose gain and the upper limit of the low pass filter is selected to match the bandwidth of the IF signal input to the discriminator.

When Band Segments 11-15 are being utilized, the gain is set at unity and the video bandwidth is set by the RC filter before the amplifier input. Since the video bandpass of the filter is approximately 60kHz and the IF bandwidth for Band Segments 11-15 is 120kHz, the Discriminator output will have a 120kHz bandpass response.

When Band Segments 4-10 are being utilized, the IF bandwidth for these band segments is 9kHz. This narrower bandwidth input into the discriminator reduces the maximum Discriminator output by a factor of 10. Because of these factors, a logic signal from the Log board (located in the lower compartment) is utilized to turn on a FET switch. When the FET switch is activated, it places an RC circuit in the feedback path of the output amplifier, which increases its gain by 20dB and simultaneously restricts the video bandpass to approximately 4.5kHz. This results in a Discriminator output having a response equal to a 9kHz bandpass.

In a similar manner, when Band Segments 1-3 are utilized, a logic signal from the Log board turns on a second FET switch (the first FET switch is now deactivated) which places a different RC circuit in the feedback path of the amplifier. This increases the amplifier gain by approximately 40dB and, as above, simultaneously restricts the video bandpass to 100Hz. This results in a Discriminator output having a response equal to a 200Hz bandpass.

The output of the Discriminator (A3J5) goes via a coaxial cable to the Auto Sweep/Audio board A7A1A6 (located in the lower compartment).

2.2.8 DETECTOR FUNCTIONS

The envelope detected output of the Linear Module (A4J4) is coupled via coaxial cables to the three detector boards: PEAK Detector, QUASI-PEAK/CARRIER Detector, and the RMS Detector. These three P.C. boards are mounted in a card guide rack located in the lower compartment of the CPR-25. The function and operation of each detector board will be covered in turn during the following discussion.

2.2.8.1 PEAK DETECTOR BOARD (A7A1A2)

The Peak Detector board contains the peak detection circuitry for the CPR-25 and utilizes FET switches to modify the peak circuit for use as a slideback detector. In addition, other FET switches control the RMS/E PEAK discharge times and the external Dump Control.

When the Peak function is being utilized a logic signal (PEAK=HIGH) from the Detector Logic board activated two FET switches. One FET switch connects the envelope detected video input signal to the audio output of the Peak Detector board, which allows the video signal to be heard audibly via the earphones. A second FET switch connects the peak charge capacitor between the diode detector output and ground.

The envelope detected video signal from the Linear Detector Module (A4) is applied to an active detector circuit which consists of a FET input operational amplifier, a detector driver stage, a diode detector, a charge capacitor, and a FET input unity gain buffer amplifier, which also functions as a feedback and output amplifier. A sudden increase in the video input signal level will cause the peak charge capacitor to charge rapidly, since the detector driver amplifier is operating essentially open-loop until the capacitor charge is equal to the input level. Once this occurs, the detector driver stage has unity gain because of the feedback from the buffer amplifier. Under normal Peak circuit operating conditions, with the Dump circuit turned off, the capacitor charge decays very slowly since the discharge path for the capacitor is very high (hundreds of megohms).

The Auto-Dump circuit for the Peak Detector consists of an operational amplifier connected to the Peak Detector output. Both inputs to this operational amplifier are connected through resistive circuitry to the Peak Detector output. However, under static conditions, the noninverting input is biased slightly negative by a resistor going to the slideback logic line. The resultant negative output of the Auto-Dump Amplifier forward biases a diode which causes the peak charge capacitor to be discharged through a resistor. If the Peak-Detector output should suddenly increase, the noninverting input to the Auto-Dump amplifier will sense this charge immediately, but the inverting input will not. This is due to the fact that a capacitor, from the inverting input to ground, must charge up, thus preventing any immediate changes on the input. The amplifier output will swing positive, which back biases the Dump diode and allows the charge to remain on the peak charge capacitor. When the capacitor on the inverting input of the Auto-Dump amplifier becomes charged (about 2 seconds), the Auto-Dump amplifier output will swing negative and discharge the peak charge capacitor to be discharged as described above. When the CPR-25 Receiver is being controlled remotely, it is desirable to dump the detector on command in order to prepare it for a new measurement. This is accomplished by a logic high input signal on the Remote-Dump input that activates a FET switch, which dumps the detector on command.

When making RMS/PEAK measurements, it is necessary that the decay rate on the peak charge capacitor be equivalent to the front panel selected time constant (0.6, 5.0, 20 seconds). A logic signal (RMS/E=HIGH) from the Detector Logic board activates a FET switch which connects the RMS/E discharge circuit into the Peak charge circuit. The RMS/E discharge circuit consists of a unity gain voltage follower whose output provides a high resistance discharge path for the peak charge capacitor via the FET switch. The input to this voltage follower is the divided-down detector driver output voltage. How much the detector driver voltage output is divided-down depends on the position of the front panel TIME CONSTANT switch, since two FET switches use logic derived from this switch to vary the voltage division. When the TIME CONSTANT switch is in the 20 second position, neither of the two FET switches is activated. The input to the voltage follower is thus set at about 95% of the charge level on the peak charge capacitor, which lengthen the discharge/decay time to 20 seconds because of the added voltage applied to the peak charge capacitor. The 5 second position of the switch activates a FET switch that sets the input to the voltage follower at about 85% of the peak charge capacitor level resulting in a discharge/decay time of 5 seconds. The 0.6 second position of the switch activates a FET switch that reduces the input to the voltage follower to nearly zero resulting in a discharge/decay time of 0.6 seconds.

A level comparator, connected to the output of the Peak Detector, constitutes an overload detector circuit. One input to the comparator is the Peak Detector output while the second input is a DC voltage, which is set by means of a screwdriver adjustable potentiometer (Overload Threshold Level Adjustment). The source for the DC Threshold reference is provided by three FET switches on the RMS Detector board (A7A1A1). The FET switches are controlled by the IF attenuator and Band Segments 11-15 logic which vary the overload threshold voltage depending upon the IF attenuation and whether the upper band segments are being utilized. When the Peak Detector output level exceeds the DC threshold level setting, the threshold detector's output swings positive and sends a logic signal (OVERLOAD=HIGH) to the Attenuator Display board (A1A4). In addition, it initiates the operation of a 1.0Hz multivibrator circuit which is also sent to the Attenuator Display board via the Attenuator C board where it blanks the Attenuator LCD Display and causes it to flash OL at a 1.0Hz rate. The multivibrator circuit operation provides a dump signal to the Peak Detector circuit via a return loop. Thus, a transient overload will cause only one multivibrator cycle (one flash of the OL display) since the multivibrator output will in turn "dump" the peak charge capacitor charge and reduce the Peak Detector output level below the DC overload threshold. However, a repetitious high level impulse or continuous overload CW signal will produce a constant OL flashing display. The overload circuitry will operate for all Detector functions since the Peak Detection circuit is always activated.

2.2.8.1.1 SLIDEBACK OPERATION

A logic signal (Slideback=HIGH) from the Detector Logic board A7A1A11 activates two FET switches to convert the Peak Detector to a Slideback Detector. One FET switch connects the Peak Detector circuit output directly to the Audio Amplifier output of the Peak Detector board while a second FET switch connects a DC bias voltage from the front panel Slideback control to the detector circuit. A logic signal (Slideback=LOW) from the Detector Logic board turns off two FET switches which disconnects the video input from the Peak Detector Audio output and the peak charge capacitor from ground. The detector circuit will now pass only that portion of the input video signal that exceeds the slideback bias DC threshold level. The DC threshold level is read on the front panel meter, with attenuation and other factors (antennas, probes, etc.), in terms of dBuV.

The peak detected output signal of the Peak Detector board is applied to the peak input of the Log Amplifier board (A7A1A4).

2.2.8.2 RMS DETECTOR BOARD (A7A1A1)

The envelope detected video signal from the Linear Detector Module (A4) is applied to an active detector circuit on the RMS Detector board. The active RMS detector is a microcircuit device which utilizes the mirror-image system of RMS detection to compute the true RMS level of the input video signal. The detector output is a DC voltage level equivalent to the true RMS level and representing the average power of the video signal. The normal averaging period for the detector is set by a fixed external capacitor at 600 msec. In addition, for RMS/E measurements, the detector's averaging period is selectable for the three time constants (0.6, 5.0, 20 seconds) positions of the front panel TIME CONSTANT switch. This is accomplished by utilizing FET switches to place additional capacitance in parallel with the fixed capacitor for the detector's averaging circuit. The FET switches are controlled by nor-gate CMOS logic which inhibits the switches from being activated except when the RMS/E Output Function is selected. In addition, the detectors averaging circuit has a dump circuit which is only activated for remote operations and is used to quickly prepare the detector for a new reading. The time constant and dump logic outputs from the RMS Detector board are sent to the Peak and Quasi-Peak/Carrier boards to control the time constant and dump circuits for the respective detection circuits. The RMS detector microcircuit output is applied to the non-inverting input of a gain equalization operational amplifier. The amplifier uses screwdriver adjustable gain and zero adjustments to obtain gain correlation between the Peak and RMS detectors. The RMS detector board output is applied to the RMS input of the Log Amplifier board.

2.2.8.3 QUASI-PEAK/CARRIER DETECTOR BOARD (A7A1A3)

The Quasi-Peak/Carrier Detector board contains the QP detection circuitry for the CPR-25 and utilizes a FET switch to modify the circuit for use as a carrier detector. In addition, other FET switches modify the detector's charge and discharge times and provides a means of external dump control for remote operations.

The envelope detected video signal from the Linear Detector Module (A4) is applied to an active detector which consists of an operational amplifier whose output drives a diode detector. The feedback path of the operational amplifier is via a unity gain voltage follower. This results in a unity gain detector whose source impedance is very low when signal levels exceed the diode bias level and very high when signal levels are below the diode bias level. The detector diode bias level is set by the charge voltage level on the charging capacitors. The operational amplifier utilizes a screwdriver adjustable zero adjustment to cancel out any input offsets to the amplifier. The value of the charging capacitor plus its series charge and shunt discharge paths are selected by FET switches which are activated by nor-gate CMOS logic on front panel switch commands. The detector output is buffered by an operational amplifier whose gain is nominally set at unity but has screwdriver adjustable gain and zero adjustments to match the detector CW output to the peak detector output.

2.2.8.3.1 CARRIER OPERATION

When the CARRIER position of the front panel Detector Function switch is selected, the Detector Logic board (A7A1A11) sends a logic command (CARR.=LOW) to nor-gate CMOS logic circuitry on the Quasi-Peak/Carrier Detector board. The logic circuitry produces a CARRIER=HIGH logic signal which activates FET switch Q3. This establishes a relatively low impedance for the charging circuit comprised of resistor R8 and capacitor C5, which results in a 0.6 second charge time. The discharge path for capacitor C5 is through resistors R8 and R9 resulting in an approximate 0.6 second decay time.

2.2.8.3.2 CISPR QUASI-PEAK OPERATION

When the Quasi-Peak Detector Function is selected, the charge and discharge times are required to be modified depending upon the frequency range/bandwidth selected. For Band Segments 1-3 (10kHz to 150kHz (220Hz BW)), logic signals produced by command inputs to the Quasi-Peak/Carrier nor-gate CMOS logic circuitry activate FET switches Q2 and Q5. The relatively low value of resistor R13 in series with Q5 results in the required 600 msec. discharge time for capacitor C5. When Band Segments 4-10 (150kHz to 30MHz (9kHz BW)) are selected, logic commands activate FET switches Q1 and Q6. The value of resistor R6 in series with Q1 results in a charge time for capacitor C5 of 1.0 msec, while the value of resistor R15 in series with Q6 results in a discharge time for capacitor C5 of 160 msec. When Band Segments 11-15 (25MHz to 1000MHz (120kHz Bw)) are selected, logic commands activate FET switches Q1 and Q5, which results in a 1.0 msec. charge and 550 msec. discharge time for capacitor C5.

2.2.8.3.3 QUASI-PEAK/CARRIER RMS/E OPERATION

When the RMS/E DETECTOR OUTPUT function is selected, the front panel TIME CONSTANT switch controls the charge and discharge times for both the Carrier and Quasi-Peak detector modes. For the 0.6 second position of the Time Constant switch, the charge and discharge times for the Quasi-Peak/Carrier detector is unchanged from the normal mode of operation. When the 5.0 second position of the Time Constant switch is selected, logic commands (from the RMS-Detector board) activates FET switch Q7. This places capacitor C6 (2.0uFd) in parallel with capacitor C5 and increases the charge and discharge times by a factor of 8. When the 20 second position of the Time Constant switch is selected, logic commands activates FET switch Q8. This places capacitor C7 (10mFd) in parallel with capacitor C5 and increases the charge and discharge times by a factor of 20.

2.2.8.3.4 DUMP OPERATION

For the normal mode of CPR-25, the Quasi-Peak/Carrier Detector has such a short decay time compared to the Peak Detector that a dump circuit is not required. In the remote mode of CPR-25 operation, an external dump signal activates FET switch Q4 which shorts the charge capacitor C5 to ground via a relatively low value resistor R11. This quickly prepares the detector for another reading which increases measurement responses for automated/remote control operations.

2.2.9 LOG AMPLIFIER BOARD (A7A1A4)

The Log Amplifier board contains the logging circuitry for the CPR-25 and performs the following functions:

a. Presents the selected Detector Function outputs in either a logged or linear presentation to the front panel meter and the external Y1 output.

b. In the Log position of the Detector Output switch produces a logarithmic output of the video input signal.

c. In the Linear position of the Detector Output switch provides the required gain for an accurate linear output.

d. When the RMS/E position of the Detector Output switch is selected, it performs the required RMS/E analog division.

e. When in the Log position, provides the signal offset levels to compensate for the different pre-detector gain of the different frequency bandwidth.

f. For the CISPR-Quasi-Peak Detector Function provides the different CISPR dictated meter time constants, by changing source impedance.

g. Utilizes logic inverters and level shifters to provide some logic signal sources for other CPR-25 circuitry.

2.2.9.1 LOG AMPLIFIER BOARD OPERATION

The three detector board outputs (PEAK, RMS, QUASI-PEAK/CARRIER) are separately applied to the Log Amplifier board which utilizes three FET switches (Q_2, Q_3, Q_4) to select the desired input. A fourth FET switch (Q_1) is utilized to apply the RMS Detector output signal to the log-ratio detection circuitry for RMS/E measurements. These and several additional FET switches utilized by the Log Amplifier board are activated by logic command signals from the Detector Logic board (A7A1A11).

The logging amplifier is a current operated microcircuit device which has the current representing the selected detector's video input applied via a load resistor to one of two low impedance inputs. For the LOG position of the DETECTOR OUTPUT switch, the second input has a DC reference current applied from an operational amplifier (U2) being utilized as a constant current source. A screwdriver adjustment (R5 LOG ZERO) sets the operating point for the log by controlling the DC level to the noninverting input of the operational amplifier. For the RMS/E position of the Detector Output switch, FET switch Q1 is activated which applies the RMS Detector output signal to the noninverting input of operational amplifier U2. The constant current source is now referenced to the RMS Detector output signal level which sets the current level applied to the reference input of the logging amplifier. This converts the logging amplifier into a log-ratio detector, since for the same input signal the current drives into the two logging amplifier inputs will be equal and the logged output zero. For two different input signals the current drives into the two logging amplifier inputs will be unbalanced and the logged output thus will be the difference of the logs of the two inputs. The logging amplifier circuit utilizes the following three screwdriver adjustments to set its operating parameters:

a. Adjustment R15 (LOG BALANCE) compensates for any inbalances in the logging circuit.

b. Adjustment R24 (LOG GAIN) sets the log output gain level with a known input signal level.

c. Adjustment R20 (BANDS 11-15 OFFSET) sets the initial (for Bands 11-15, 120kHz bandwidth) pre-detector gain compensation offset level. This is a positive offset of 30dB, since the pre-detector gain for Bands 11-15 (120kHz BW) is 30dB lower than for Bands 1-3 (220Hz BW).

The offset and inverted output of the logging amplifier circuit is applied to the inverting input of an operational amplifier (U4B). The operational amplifier plus several FET switches are utilized to perform the following functions:

a. To provide the correct pre-detector offsets for Bands 1-3 (220Hz BW) and Bands 4-10 (9kHz BW) for the LOG position of the DETECTOR OUTPUT switch.

b. To provide the correct offsets and gains for RMS/E measurements.

The offset circuitry is connected via FET switch Q7 to the inverting input of operational amplifier U4B. Within the offset circuitry itself, FET switches Q8, Q9 and Q10 are used to control the degree of offset required for each of the three CISPR bandwidths employed by the CPR-25. The offset circuitry functions in the following manner:

Whenever the LOG position of the DETECTOR OUTPUT switch is selected, a logic command signal from the Detector Logic board activates FET switch Q7 and enables the offset circuitry. The same logic signal also activates FET switch Q8 which grounds resistor R33 and thus sets the bias level on the noninverting input of operational amplifier U4B at or near ground. When Band Segments 11-15 (120kHz BW) are selected, FET switch Q9 is activated and grounds the offset biasing network. Thus, for Band Segments 11-15 the amount of offset is controlled by the previously described offset located in the logging amplifer circuit. When Band Segments 4-10 (9kHz BW) are selected, FET switch Q10 is activated which forms a voltage divider to ground in the offset biasing network. The network comprises resistors R25, R26, R27, R29, and R30 which sets the offset for Band Segments 4-10 at +20dB, since the pre-detector gain for Band Segments 4-10 is 20dB lower than for Band Segments 1-3 (220Hz) are selected, FET switches Q9 and Q10 are turned off and this produces a voltage divider network comprising resistors R25, R26, and R27 which sets the offset for Band Segments 1-3 at 0dB. Screwdriver adjustment R26 (BANDS 1-3 OFFSET) is adjusted to set a positive offset current onto the inverting input of operational amplifier U4B. Since the output of the logging amplifier is inverted, the +30dB offset set by R20 (BANDS 11-15 OFFSET) becomes -30dB. This is then subtracted from the +30dB offset of the offset biasing circuitry resulting in a total offset of 0dB for Bands 1-3. For Band Segments 4-10, screwdriver adjustment R30 (BANDS 4-10 OFFSET) is adjusted to apply a positive current equal to +10dB onto the inverting input of U4B. When subtracted from the inverted logging amplifier output of -30dB, the resulting -20dB is inverted by U4B and results in the +20dB offset for Bands 4-10. Due to interaction between the three offset adjustments, they are adjusted in the following sequence to obtain the required results:

1st Adjustment:	Band 11-15 OFFSET set at +30dB by R20.
2nd Adjustment:	Band 1-3 OFFSET set at 0dB by R26.
3rd Adjustment:	Band 4-10 OFFSET set at +20dB by R30.

In addition to being applied to the inverting input of operational amplifier U4B, the offset circuitry output is also applied to the PEN #2 DRIVER BOARD (A7A1A5). This provides the same offset levels to the PEN #2 logging circuit for use in driving the #2 Pen of a dual pen X-Y recorder.

2.2.9.1.1 RMS/E OFFSET

When the RMS/E position of the Detector Output switch is selected, FET switches Q7 and Q8 are turned off. This disables the switched offset circuitry to the inverting input of U4B and enables the offset circuitry on the noninverting input of U4B. This is a voltage divider network comprised of resistors R32, R33, R34, R35, and the front panel ZERO CONTROL adjustment (A1R1) which applies a positive bias current to the noninverting input. Under RMS/E measurement conditions, the total offset is approximately 40dB with 30dB set by adjustment R20 (BANDS 11-15 OFFSET) in the logging amplifier circuit and 10dB controlled by the front panel ZERO CONTROL adjustment (A1R1).

The ZERO position of the Detector Output switch results in the RMS/E function of RMS/RMS. Since for this measurement the log amplifier output will be OVDC,the front panel meter should read 0dB on the -40 to +40dB log scale. The front panel ZERO adjustment is utilized to vary the amount of offset needed by operational amplifier U4B to compensate for any circuitry imbalances and set the 0dB meter reading.

2.2.9.1.2 LOG OUTPUT SWITCHING

Four FET switches are utilized to connect either the linear or logged output signals to the front panel meter and external output connectors.

When the LOG position of the DETECTOR OUTPUT switch is selected, FET switches Q13 and Q14 are activated. Q14 drives the front panel meter multiplier circuit consisting of R39 and R40. Screwdriver adjustment R40 (METER CAL) calibrates the front panel meter for a full scale meter reading with an input of 1.5 VDC to the Log Amplifier. Q13 bypasses the meter multiplier circuit and connects the log output to the PEN #1 output (Y1) on the rear panel plotter connector (A7J6) and Remote Control connector (A7J7). These same FET switches are also activated for the RMS/E position of the DETECTOR OUTPUT switch.

When the Linear (LIN) position of the DETECTOR OUTPUT is selected, FET switches Q16 and Q6 are activated. Q16 connects the output of the Linear amplifier via a switched multiplier circuit to the front panel meter, while Q6 bypasses the switched multiplier circuit and connects the Linear output to the PEN #1 (Y1) output on the Plotter and Remote Control connectors. The switched meter multiplier circuit is the result of CISPR requirements which specify different meter time constants for different frequency ranges. The CISPR specifications thus require a 160 msec meter time constant for Bands 1-10 and a 100 msec meter time constant for Bands 11-15. For Bands 11-15, FET switch Q15 is turned off and the meter's source impedance consists primarily of meter multiplier resistor R41. For Bands 1-10 FET switch Q15 is activated which places resistor R42 in parallel with resistor R41 and adds screwdriver adjustment R43 (BANDS 1-10 METER BALANCE) to ground. R43 is utilized to match the meter readings in Bands 1-10 with the meter readings in Bands 11-15 for the same input driving voltage. The resulting voltage divider network decreases the meter source impedance which changes the meter's response time.

2.2.10 PEN #2 DRIVER BOARD (A7A1A5)

The PEN #2 Driver board is an additional log/linear amplifier circuit which drives the PEN #2 (Y2) output for a dual pen x-y recorder and whose input is either the RMS Detector or PEAK Detector output signal. Two FET switches (Q1, Q2), activated by the front panel PEN #2 switch (RMS-AVE-PEAK), select the desired input and feed a logging amplifier and a linear amplifier circuit connected in parallel. The logging amplifier is the same microcircuit device utilized on the Log Amplifier P.C. board. It operates in the same manner with the exception that the log reference input is referenced via an adjustable voltage divider network to +12VDC rather than an active current source. The following five screwdriver adjustments are utilized to set the operating parameters of the logging circuit:

a. Adjustment R14 (BIAS) is the log reference adjustment and sets the operating point for log by controlling the DC current level into the reference input of the logging amplifier.

b. Adjustment R6 (LOG GAIN) sets the log output gain level with a known input signal level.

c. Adjustment R11 (ZERO) compensates for any inbalances in the logging circuit.

d. Adjustment R4 (BANDS 11-15 OFFSET) sets the initial offset for the logging amplifier at +30dB.

e. Adjustment R17 (BANDS 1-10 OFFSET) adjusts the level of the switched offset to the output amplifier U2 so that for Bands 1-3, the offset is approximately 0dB and for Bands 4-10, the offset is approximately 20dB.

The Bands 11-15 offset and Bands 1-10 switched offset voltages are obtained from the Log Amplifier board (A7A1A4). The inverted output of the logging amplifier is applied to the inverted input of an operational amplifier (U2) whose output is switched by FET switch Q3. When activated in the Log mode of operation, Q3 applies the logged signal to the PEN #2 (Y2) output of the Plotter connector (A7J6) and the Y_2 output of the Remote Control connector (A7J7).

When the Linear mode of operation is selected, FED switch Q4 is activated which applies the output of a voltage follower linear amplifier to the Y_2 outputs of the rear panel connectors mentioned previously.

2.2.11 ATTENUATOR CONTROL/DISPLAY LOGIC CIRCUITRY

The Attenuator Control/Display Logic Circuitry comprises four different PC boards. Three of the boards (Attenuators A, B, C) are located in the lower compartment of the CPR-25 while a fourth board (Attenuator Display) is located on the front panel above the analog meter.

2.2.11.1 ATTENUATOR A BOARD (A7A1A10)

The function of the Attenuator A board is to provide local control of the IF/RF attenuator selection process. Local attenuation control is provided by two pushbutton switches (A1S1 STEP-UP, A1S2 STEP-DOWN) located on the front panel next to the Attenuator Display. The normally open contact of each switch is connected to ground, while the common of each switch is applied to a separate input on the A board. A one-shot multivibrator circuit located on each input is activated whenever the switch for that input is pressed. The output of each one-shot circuit is applied to an input on a Count UP/DOWN BCD-Decade counter corresponding to the function of the switch activating the one-shot. Thus, the output of one circuit is applied to the count down input. Logic circuitry on the Decade Counter outputs separates the output levels into IF and RF Attenuator logic command signals according to the following truth table.

Count inhibiting circuitry prevents counter outputs below 0000 and above 1001. Reset circuitry produces a 0000 setting whenever the CPR-25 is turned on. The IF and RF Attenuator local logic command outputs from the A board are applied to the Attenuator B board.

2.2.11.2 ATTENUATOR B BOARD (A7A1A9)

The function of the Attenuator B board is to integrate the various logic inputs and command information into logic command outputs for use by the IF/RF attenuators and the buffer for the Attenuator Display. The Attenuator B board receives the following logic command information:

a. IF/RF attenuators local command logic from Attenuator A board.

b. IF/RF attenuators remote command logic from the Remote Control Connector A7J7 (GND=ACTIVATED).

c. Remote/local logic from the front panel LOCAL/REMOTE switch A1S3 (REMOTE=GND).

d. Cal logic from the front panel CAL switch A1S9 (CAL=HIGH).

TABLE 2-1

ATTENUATOR A BOARD IF/RF ATTENUATION LOGIC OUTPUTS

IF ATTEN	RF ATTEN	TOTAL ATTEN	COUNTER OUTPUTS	IF_{L1} OUTPUT	RF_{L1} OUTPUT	RF_{L2} OUTPUT	RF_{L3} OUTPUT
0dB	0dB	0dB	0000	L	L	L	L
10dB	0dB	10dB	0001	H	L	L	L
10dB	10dB	20dB	0010	H	H	L	L
10dB	20dB	30dB	0011	H	L	H	L
10dB	30dB	40dB	0100	H	L	H	L
10dB	40dB	50dB	0101	H	H	H	L
10dB	50dB	60dB	0110	H	H	L	H
10dB	60dB	70dB	0111	H	L	H	H
10dB	70dB	80dB	1000	H	H	H	H

e. LIN/LOG from the Detector Logic board A7A1A11 (LOG=HIGH).

f. Band logic signal from the Preselector/Mixer where Bands 1-3=HIGH, Bands 4-10=HIGH, and Bands 11-15=HIGH for their respective inputs when utilized.

The remote/local command logic from the front panel LOCAL/REMOTE switch (REMOTE= GND, LOCAL=OPEN) selects the attenuator's mode of operation by controlling the output states of a series of nor-gates are divided into two groups; one group receives the various input logic commands, while the second group functions as output drivers/buffers. For local attenuation control, a set of nor-gates which receives inputs from the Remote Control connectors is activated. The driver/buffer nor-gate outputs are then utilized to drive the following:

a. Three binary output lines from one set of nor-gates to the Attenuator Drive board (A2A19) on the Preselector Assembly (A2) for selection of the RF Attenuator level.

b. Three logic command lines (0dB, 10dB, 20dB=HIGH) from another set of norgates drive the IF attenuators located in the IF Amplifier Assembly (A3A1,A3A2). (NOTE: 20dB used only in CAL and REMOTE by A3A2).

c. An adder circuit which sums the total selected IF/RF attenuation logic levels and provides a binary output of the total to the Attenuator C board. The band range logic inputs plus the CAL command logic are also included in the logic information applied to the IF attenuators nor-gate output drivers. This allows the IF attenuators to be preset according to the frequency band range whenever the CPR-25 Receiver is being calibrated, in order to obtain the correct front panel meter reading in response to an impulse generator input (for either internal or external CAL conditions). For CAL conditions, the IF attenuators are preset as follows:

Band Range	IF Attenuation Preset
1-3	0dB
4-10	0dB
11-15	20dB

In addition to the above outputs, two other logic outputs also utilize the band range logic inputs. These are the Linear Attenuator Offsets (enabled by the LIN=LOW logic) which are used to develop the required Attenuator Display Offsets whenever Linear measurements are being made. The Linear Offsets are applied to the Attenuator C board as follows:

Band Range	Output #1	Output #2	Total Offset
1-3	LOW=0dB Offset	LOW=0dB Offset	0dB
4-10	HIGH=20dB Offset	LOW=0dB Offset	20dB
11-15	HIGH=10dB Offset	HIGH=20dB Offset	30dB

2.2.11.3 ATTENUATOR C BOARD (A7A1A8)

The Attenuator C board integrated the logic information received from several sources and utilizes it to drive the Attenuator Display board (A1A4). The Attenuator B board provides a binary output of the total IF/RF attenuation to the C board plus the Linear Offsets needed for correct meter readings when making linear measurements. The Attenuator C board utilizes circuitry comprising two binary adders, and a binary multiplexer to produce the output required for the operation of the Attenuator Display board. The C board produces the following outputs:

a. A four digit BCD output which represents the 10 digit of the Attenuator Display (ACTIVE= HIGH). This output is produced from the binary coded input of the total IF/RF attenuation.

b. A single line output which represents the sign of the attenuation (PLUS (+)=HIGH, MINUS (-)=LOW).

The circuitry also integrates the Linear Offsets (When LIN = HIGH input is activated) into the BCD outputs for the 10^1 digit to produce the correct Attenuator Display whenever linear measurements are being made.

The table below gives the offset to be added/ subtracted from the attenuation total versus band range and the total attenuator range utilized.

Band Range	**Offset Correction Subtracted/Added**	**Total Attenuation Range Utilized**
1-3	−20dB	−20dB to + 60dB
4-10	No Correction Made	0dB to + 80dB
11-15		
11-15	+10dB	+10dB to + 90dB

The Peak Detector board (A7A1A2) provides the overload logic information to the Attenuator C board to enable proper operation of the overload function of the Attenuator Display. The overload logic information consist of two inputs; an OVERLOAD = HIGH input and an OVERLOAD = 1Hz SQUARE WAVE input. The OVERLOAD = HIGH input signal is utilized to blank the numeric display, while the 1Hz square wave causes the letters OL to flash on the display.

An additional input to the Attenuator C board is the RMS/E = HIGH signal from the Detector Logic board (A7A1A11). The RMS/E input signal produces an Attenuator C board output which blanks the Attenuator Display readout whenever RMS/E measurements are being taken. This is done primarily to prevent confusion since the IF/RF attenuator settings do not enter into the actual determination of the RMS/E ratio amplitude reading.

2.2.11.4 ATTENUATOR DISPLAY BOARD (A1A4)

The Attenuator Display board, located on the front panel above the analog meter, contains the Liquid Crystal Display readout and the decoder/ driver circuitry required to drive the display. The LCD readout comprises three and one half digits and a plus/minus attenuator polarity sign. The Attenuator C board provides all the logic signal inputs required for operation of the Attenuator Display board.

The first of 10° digit of the display is located on the righthand side of the display and is only activated to form the L for an overload indication. The second or 10^1 digit of the display is always 0 when activated and forms the 10° digit of the attenuation display. In addition, it also forms the 0 for the OL indication.

NOTE: Whenever an overload condition is present, a 1Hz square wave from the Attenuator C board causes the OL display to blink at a 1Hz repetition rate.

The third or 10^2 digit of the display forms the 10^1 digit of the attenuator readout. A BCD to 7 segment decoder/driver forms the digits 0 through 9 for the 00 to 90 dB range attenuation display. The fourth digit, the numeral 1, is always blanked. The last section of the display readout is a plus/ minus sign for indicating attenuation polarity. The minus (-) indication is continuously activated (except when blanked for RMS/E measurements) while the plus (+) sign is formed when two vertical bars are enabled.

The decoder/driver circuitry for the LCD readout utilizes a 50Hz multivibrator source to drive the Liquid Crystal Display. This is due to the fact that a Liquid Crystal Display deteriorates due to electrolysis when driver from a DC source.

2.2.12 DETECTOR LOGIC BOARD (A7A1A11)

The Detector Logic board provides the logic command signals utilized by the three Detector boards (RMS, PEAK, QUASI-PEAK/CARRIER) plus several other boards/modules to enable the circuitry required for the selected output and function. The board, located in the lower compartment card guide, receives its logic input information from the CPR-25 front panel for the local mode of control and from the Remote Control connector (A7J7) for the remote mode of control. The board's (and thus the receiver's) mode of control is set by the Local/Remote switch (A1S3) whose input (LOCAL=OPEN, REMOTE=ACTIVE LOW) determines the output states of a series of nor-gates.

In the local mode of unit control, the front panel DETECTOR FUNCTION OUTPUT switches, CAL GAIN CONTROL, and FREQUENCY RANGE switches provide the logic input information. The CARRIER, RMS, PEAK, and SLIDEBACK positions of the DETECTOR FUNCTION switch and the LIN, RMS/E, and ZERO positions of the DETECTOR OUTPUT switch are connected to inputs on the Detector Logic board, while there are no connections for the QUASI-PEAK and LOG positions of these respective switches. The commons of the Detector Function and Output switches are connected via the front panel CAL switch (A1S9) to a remote CAL control circuit on the Detector Logic board, whose output is nominally a logic low except when a remote CAL input signal is present. Therefore, when any of the DETECTOR FUNCTION OUTPUT switch positions except QUASI-PEAK and LOG are selected, a logic low will be present on the selected input to the Detector Logic board which activates nor-gate circuitry to enable that function/output. When the QUASI-PEAK and LOG positions of these respective switches are selected, the inputs from the other switch positions are forced HIGH due to pullup resistors to the plus supply on the board. This forces nor-gate U4-PIN 4 and nor-gate U5-pin 11 HIGH which activates the LOG output and QUASI-PEAK function respectively.

In the remote mode of unit control, the Remote Control connector (A7J7) provides the logic input information to the Detector Logic board. The DETECTOR functions and OUTPUTS are selected in the same manner as for local control; an active LOW input selects the desired DETECTOR FUNCTION of CARRIER, RMS, PEAK or SLIDEBACK and DETECTOR OUTPUT of LIN, RMS/E, or ZERO. In a similar manner, an absence of an active LOW input to all of the preceding Detector Function/Output inputs to the Detector Logic board will select the QUASI-PEAK function and LOG output in the way described for local control.

When calibration mode for the CPR-25 is selected, utilizing either the front panel CAL switch (A1S9) or the remote CAL signal input from the Remote Control connector, the common inputs to the front panel DETECTOR switches goes to a logic high. This forces the DETECTOR OUTPUT to the LOG position and DETECTOR FUNCTION to the QUASI-PEAK position (as per the explanations given in the previous paragraphs) regardless of the actual positions of the DETECTOR switches. In addition, an output from the remote CAL control circuit forces the local/remote control circuit to select the local mode of control overriding the logic input command from the front panel LOCAL/REMOTE switch. The outputs for the Detector Logic board are as follows:

A. The LOG/LIN logic signal output on A7A1A11-A is bi-level and functions as follows:

   1. When the LOG detector Output is selected: A LOG=HIGH logic signal is applied to the Log Amplifier board (A7A1A4), the PEN #2 Driver Board (A7A1A5), and the Attenuator B board (A7A1A9). The logic signal activates the log detection circuitry on the Log Amplifier and PEN #2 Driver Boards, while on the Attenuator B board it provides the correct logic for the Attenuator Display readout in LOG.
   2. When the LIN Detector Output is selected: A LIN=LOW logic signal is applied to the boards listed in A-1. On the log Amplifier board the logic low signal is applied to a nor-gate which forces its output HIGH and activates the linear detection circuitry. On the PEN #2 Driver board the logic low signal insures that the log detection circuitry is turned off, while the linear amplifier is activated by the LIN=HIGH signal from the Log Amplifier board. On the Attenuator B board the logic signal is utilized to provide the correct linear offsets to the Attenuator Display board.

B. An RMS/E=LOW logic signal on A7A1A11-F is sent to the Log Amplifier board (A7A1A4) to convert the log detection circuitry to a log ratio detection circuit. The logic signal is also sent to the RMS Detector board (A7A1A1) when it enables a circuit to allow the time constants for the RMS/E Detector Mode to be set by the front panel TIME CONSTANT switch (A1S5).

C. A SLIDEBACK=HIGH on A7A1A11-K and SLIDEBACK=LOW on A7A1A11-12 logic signals to the Peak Detector board (A7A1A2) to switch the detector to the SLIDEBACK mode of operation.

D. A PEAK=LOW signal to the Log Amplifier board (A7A1A4) to switch the Peak Detector board output to the log detection circuitry for signal processing.

E. A CARRIER or QUASI-PEAK=HIGH logic signal of A7A1A11-J to the Log Amplifier board (A7A1A4) to switch the Quasi-Peak/Carrier board output to the log detection circuitry for signal processing.

F. An RMS=LOW logic signal on A7A1A11-10 to the Log Amplifier board (A7A1A4) to switch the RMS Detector board output to the log detection circuitry for signal processing.

G. The Quasi-Peak/Carrier logic signal output on A7A1A11-11 is bi-level and functions as follows:

   1. A QUASI-PEAK=HIGH logic signal to the Quasi-Peak/Carrier Detector board (A7A1A3) to activate the quasi-peak detection circuitry.
   2. A CARRIER=LOW logic signal to the Quasi-Peak/Carrier Detector Board (A7A1A3) to activate the carrier detection circuitry.

In addition to the above Detector control functions, the Detector Logic board also include logic circuitry to select between the local or remote modes of unit control for the FREQUENCY RANGE band select and the CAL GAIN control. The logic circuitry controls a series of transistor switches which select between the front panel FREQUENCY RANGE switches or the Remote Control connector to supply the BAND STEP UP (↑) = HIGH or BAND STEP DOWN (↓) = HIGH logic signals to the Band Control board (A6A3). In a similar manner the logic circuitry controls the CAL GAIN (0 to +12VDC analog signal) level to the Linear Detector Module (A4).

2.2.13 FREQUENCY RANGE STEP CONTROL CIRCUITRY

The CPR-25 Preselector Module (A2) contains a motor driven turret mechanism which is utilized to position one of fifteen band segments (Covering the 10kHz to 1GHz frequency range of the receiver) against thirty finger spring contacts. The reversible geared DC motor drives the turret via a magnetic clutch which permits the selected band segment to be positioned and then held in place by a spring action detent arm. A micro-switch, activated by the detent arm indicated when the band segment is properly positioned. The direction and duration of the motor operation is controlled by the Band Control board (A6A3) in conjunction with the front panel FREQUENCY RANGE switches.

2.2.13.1 BAND CONTROL BOARD (A6A3)

The Band Control PC board is located in a card guide bracket which is attached to the front of the Power Supply Module (A6) which is in the rear of the upper compartment. The PC board comprises two discrete cathode-coupled latch circuits which drive the motor/clutch control circuitry.

Each latch circuit drives a pair of Darlington transistor switches, with one of the latch circuits controlling the forward motor operation (STEP UP ↑) and the other latch circuit controlling the reverse motor operation (STEP DOWN ↓). The selected latch circuit is switched to its motor-on state by a high level logic command (STEP UP ↑ OR STEP DOWN ↓) from the Detector Logic board (A7A1A11). The selected latch circuit in turn activates its associated pair of Darlington switches. One switch is connected between the motor and the + RAW supply. The polarity of the voltage across the motor circuit, which control the direction of motor rotation, is determined by which latch circuit and associated pair of Darlington switches is activated. Also energized along with the drive motor is the magnetic clutch, which is connected across the motor circuit via a series of diodes. The diodes enable the polarity of the clutch voltage to remain constant regardless of the motor voltage polarity. Once activated, the latch circuit will keep the motor/clutch circuitry energized until a negative pulse, initiated by the turret detent switch, indicates that a new bandstrip is in position. The negative pulse switches the latch circuit to its motor-off state thus de-energizing the motor/clutch circuitry. Whenever the motor is energized, a detent switch is activated which connects a + 20VDC (+RAW supply) to the detent input of the Band Control board and charges Capacitor C2. After the selected band segment is correctly positioned the detent switch is deactivated, grounding the detent input and discharging Capacitor C2. This generates the negative pulse that switches the latch circuit to its motor-off state. A latch inhibit circuit prevents motor reversal whenever the motor/clutch circuit is energized.

A "MOTOR ON" circuit senses when the motor/clutch drive circuitry is activated. This "MOTOR ON' signal is utilized to inhibit the operation of the high-current draining switching circuits of the optional ALR-25 or RVR-25 antennas whenever the turret drive motor is operating.

2.2.14 IF/MIXER CONTROL BOARD (A6A2)

The IF/Mixer Control board is located in a card guide bracket, next to the Band Control board (A6A3), attached to the front of the Power Supply Module (A6) in the rear of the upper compartment. The PC board contains two separate and independent circuits which perform the following:

A. One circuit (IF/MIXER CONTROL) controls the switching functions for the IF Amplifier Module (A3) and the Mixer Module (A5).

B. The second circuit (CAL LEVEL GAIN) establishes the calibration level of the internal calibration circuit.

2.2.14.1 IF/MIXER CONTROL CIRCUIT

This circuit activates the correct IF Amplifier and Mixer circuitry in response to the Pre-Selector (A2) band segment selected. The circuit receives the necessary logic information in the form of four binary band code inputs originating on the Band Position switches (A2S1B+C) connected to the Pre-Selector turret assembly shaft. For the local mode of operation, the logic signal level is normally +12 VDC but can be made compatible with any required logic level from +3 to +12VDC. The input stage consists of a CMOS level shifter circuit that permits the above range of logic levels to be utilized, with a Band Logic level output to the Band Position Switch common establishing the logic level reference.

The logic circuitry for the control circuit produces the following outputs:

A. When Band Segments 1-10 are selected, a -6VDC logic signal to the 9kHz IF Amplifier (A3A1) activates the 9kHz bandwidth circuit.

B. When Band Segments 11-15 are selected, a -6VDC logic signal to the 120kHz IF Amplifier (A3A2) activates the 120kHz bandwidth circuit.

C. When Band Segments 11-12 are selected, a -6VDC logic signal to the Mixer Module (A5) activates a diode switch and supplies the operating voltage for a transistor mixer. This allows the RF and local oscillator signal inputs from the band segments to be applied to the transistor mixer which produces the final 8.7MHz IF frequency.

D. When Band Segment 13 is selected, a -6VDC logic signal to the Mixer Module (A5) activates a diode switch, a 30MHz crystal oscillator circuit, and supplies the operating voltage for the transistor mixer. The crystal oscillator frequency of 30MHz and the first IF frequency of 38.7MHz from the band segment is applied to the transistor mixer to produce the final IF frequency of 8.7MHz.

E. When Band Segment 14 is selected, a -6VDC logic signal to the Mixer Module (A5) produces the results given above for Band Segment 13 except the crystal oscillator frequency is 60MHz and the first IF frequency is 68.7MHz.

F. When Band Segment 15 is selected, a -6VDC logic signal to the Mixer Module (A5) produces the results given above for Band Segment 14 except the crystal oscillator frequency is 90MHz and the first IF frequency is 98.7MHz.

G. When Band Segments 11-15 are selected, a +12VDC logic signal to the Log Amplifier board (A7A1A4) and Attenuator B board (A7A1A9) to control the log offset voltages required by the Attenuator Display for this frequency range.

H. Four buffered, level shifted binary band code outputs (+12v=HIGH) of the band code inputs which are utilized by the preset logic of the front panel Frequency Display Module (A1A3).

2.2.14.2 CAL LEVEL GAIN CIRCUIT

This circuit controls the output level of the internal Impulse Generator (A2A17) on a band range basis for the purpose of receiver gain calibration. Whenever the CPR-25 Receiver is to be gain calibrated, the CAL switch is pushed and the CAL GAIN control is adjusted for a 0dB reading on the Log scale of the front panel meter. This calibration method involves changing the amplitude output level of the impulse generator according to the band range being utilized, since the different bandwidths over the total band range require varying impulsive inputs to produce the same detector output. Also, in order to insure that the calibration signal is far enough above noise for the upper bands and has sufficient amplitude level for the lower bands, the IF attenuation is programmed according to the band range during calibration. Since the output amplitude of the impulse generator is directly proportional to its charging voltage, the CAL Level Gain circuit utilizes a voltage divider network with seven screwdriver adjustable CAL Level Controls to set the charge voltage level. The correct CAL Level control is switched into the divider network by the I.G. Level switch (A2S1-A), connected to the Pre-Selector turret assembly shaft, by grounding the input to that CAL Level control. The voltage divider network is driven from the +150VDC high voltage source, regulated down to +100VDC by a zener diode. The output of the divider network is the charging voltage for the impulse generator.

2.2.15 FREQUENCY DISPLAY MODULE (A1A3)

The Frequency Display Module indicates the frequency (in MHz) to which the receiver is tuned and is mounted on the CPR-25 front panel above the tuning controls. The module utilizes the local oscillator output of each RF band segment and the buffered binary band codes from the IF/Mixer Control board (A6A2).

The band code information is processed via logic circuitry to provide logic command signals to the Pre-Scaler circuit for control of the pre-scaler divider modes and to preset the frequency counter according to the IF frequency range being utilized. The Pre-Scaler circuit divides the local oscillator input frequency by 100 for RF Band Segments 11-15 and by 10 for RF Band Segments 1-10, in order to keep the input to the frequency counter circuit within its frequency range limit. A relay (controlled by the band-code-initiated logic commands) is utilized to switch between the divide-by-100 and the divide-by-10 circuitry. The output of the Pre-Scaler circuit is applied to the frequency counter circuit which also utilizes band code initiated logic to preset the counter according to the IF frequency range being utilized. The frequency counter outputs thus represent the RF input frequency rather than the local oscillator frequency. The counter outputs are applied to a series of decoder/drivers which utilize a 50Hz square wave to drive the front panel Liquid Crystal Display. A 50Hz source is used since a Liquid Crystal Display deteriorates due to electrolysis if driven from a DC source. Outputs from the frequency counter also go via buffers/multiplexers to the rear panel Remote Display connector (A7J9) to provide a remote indication of the frequency being displayed on the front panel LCD readout. In addition, three input address lines from the connector are utilized in the remote mode of unit control to command which digit of the six digit display is to be "read". The four output lines will then indicate the value of the selected digit.

A Display ON/OFF switch, located on the front panel near the CAL GAIN control, controls the voltage regulators, which supply the counter/display circuitry. In addition, this function is available in the remote mode of unit control via a Display ON/OFF input on the Remote Display connector (A7J9). Because the Display draws a considerable amount of current when operating, this function is normally utilized when the CPR-25 is using its optional internal battery pack as the sole power source. The Display, under these conditions, is usually turned off when not needed to conserve battery power.

2.2.16 POWER SUPPLY CIRCUITRY

The CPR-25 power supply contain the DC supplies and regulators required for operation of the receiver's circuits. The power supply can utilize either an external AC line source or an optional internal rechargeable battery pack as its power source.

The AC line source is nominally 120 or 220 volts, 60 to 400Hz and is also utilized to charge the optional battery. The Power Supply Module (A6) is a welded unit fastened to the receiver's main frame at the rear of the upper compartment and is accessible via a detachable cover from the outside of the receiver. The cover is part of the Inner Power Module (A6A1) which contains the input power transformer, a large filter capacitor, a card guide and connector for the Power Supply P.C. board (A6A1A1), and an external shielded heatsink to which are mounted three power transistors. On the rear of the Inner Module is a twist lock connector which allows the module to be detached completely from the Power Supply Module. The Power Supply board (A6A1A1) contains the bridge rectifier circuit and the regulating circuitry for the positive and negative raw supplies.

2.2.16.1 AC OPERATION

The unit is connected to the selected AC power source via a detachable PCD-25 power cord which connects to the AC power input connector (A6J1) on the Power Supply cover. Located above the AC Power connector is the Power Select switch (A6S1) which selects, utilizing a screwdriver blade, between 120VAC and 220VAC by connecting the dual primary windings of the input transformer either in series (220VAC) or parallel 120VAC). The Power Supply utilizes two fuses, located above the Power Select switch, with one fuse (A6F1) in the primary input circuit of the transformer and the other fuse (A6F2) in the secondary output circuit of the transformer.

The secondary of the transformer is applied across the bridge rectifier on the Power Supply board. The nominal 60VDC output of the bridge is filtered by Capacitor A6C1 (6500uF) with the negative output of the bridge applied to the receiver's negative RAW buss (-12VDC) and the positive output is applied via the front panel power switch (A1S1) to the primary regulator on the Power Supply board. When the front panel power switch is in the OFF position, the bridge output is connected to the optional battery charger circuit.

The primary voltage regulator circuit consist of a micro-circuit device (A6A1A1-U1) driving a high power Darlington series regulator (A6A1-Q1). A screwdriver adjustment (A6A1A1-R3) sets the regulated positive output voltage at +32VDC in relation to the negative RAW buss. A shunt regulator circuit consisting of a micro-circuit device (A6A1A1-U2) and two shunt pass transistors (A6A1-Q2 and Q3) establishes the positive buss voltage at +20VDC in relation to ground. The above three power devices (Q1-Q3) are mounted on an external shielded heatsink located on the cover of the Power Module (A6A1).

The shut pass transistors consists of a PNP type connected between the negative buss (-12VDC) and ground, while a NPN type is connected between the positive buss (+20VDC) and ground. The shunt regulator is utilized to equalize the current drains on the positive and negative supplies. When the receiver's circuitry requires more current from the positive supply the PNP pass transistor "passes" the excess current from the negative buss. If the receiver's circuitry requires more current from the negative supply, the NPN pass transistor "passes" the excess current from the positive buss. This method of power regulation was chosen due to the requirement for the receiver to operate from an optional internal battery supply. When utilizing a battery supply as the sole power source, a single 32V rechargeable battery pack replaces the primary AC power supply. In this case the shunt regulator is required to establish a ground reference for the battery system.

The positive RAW (+20VDC) and negative RAW (-12VDC) are used to power the high current drain and electrically noisy circuitry of the receiver such as the turret drive motor, the high voltage converter, the impulse generator, and the Frequency Display Module. This signal processing circuitry is powered by †12VDC and -6VDC regulated supplies developed from the positive and negative RAW supplies by high power micro-circuit voltage regulators. These two TO-3 sized devices are mounted on a bracket behind a heat-sink on the rear section of the lower compartment. Two screwdriver adjustments (A7A1A12-R18, R20), located on the Battery Charger and Low Voltage Cutoff board (A7A1A12), are used to set the regulated voltages to the level required. This P.C. board is located in the lower compartment A7 Card Guide Assembly.

2.2.16.2 BATTERY OPERATION

The optional BAT-25R Battery Pack (A9) permits operation of the CPR-25 Receiver independent of an AC power source and is located in the lower compartment next to the Card Rack Assembly (A7A1).

The negative side of the battery is connected to the negative RAW (-12VDC) buss, while the positive side of the battery is connected via a second pole of the front panel power switch (A1S1) through a low-voltage cut off circuit and an isolation diode (A7A1A12-CR4) to the positive RAW (+20VDC) buss. Since the battery voltage is nominally 30 VDC, whenever the AC power source is being utilized the isolation diode (CR-4) will be back biased by the 32VDC primary voltage regulator and no battery power will be drawn. A trickle charge circuit comprising a 1 WATT resistor (A6A1A1-R11) and an isolation diode (A6A1A1-CR6) connects the battery to the unregulated DC supply voltage. This permits the battery to recharge at a very low charge rate (main function of the trickle charge circuit is to keep a battery at full charge) whenever the receiver is on and connected to an AC power source.

The low voltage cut-off circuit comprises a Darlington pass transistor (A7A2-Q2) connected between the positive battery output and the positive RAW (+20VDC) buss. For normal battery operation, the pass transistor (Q2) is kept in saturation (turned on) by the conduction of a sensing transistor (A7A1A12-Q3) connected between the base of the pass transistor and the negative RAW (-12VDC). A voltage sensing circuit comprising a zener diode (A7A1A12-CR5) is connected between the base of the sensing transistor (Q3) and the positive RAW (+20VDC) buss. As long as the battery voltage remains above +24VDC, the sensing transistor will remain saturated, keeping the pass transistor turned on and the battery connected across the main supply busses. Whenever the battery voltage falls below (+24VDC) the zener diode's threshold level will be reached and it will cease conduction, thus removing the positive bias from the base of the sensing transistor (Q3). With the sensing transistor turned off, the pass transistor (A7A1-Q2) will also be turned off, removing the battery from the power circuit and deactivating the receiver. Since the voltage sensing circuit is on the applied power side of the cutoff circuit, the receiver will remain off even if the battery recovers to an operating level. In order to reactivate the receiver, the front panel power switch must be recycled (ON to OFF to ON) to have power reapplied, utilizing a turn-on circuit to the main busses.

For battery operation, the receiver uses a second pole on the Power switch to activate a turn-on circuit within the cut-off circuitry. The turn-on circuit comprises a capacitor/resistor network (A7A1A12-C1&R10) connecting the switched positive side of the battery to the base of the sense transistor (A7A1A12-Q3). When the front panel Power switch is pushed on, the initial positive power-on pulse is coupled through the network and activates the sense transistor which in turn activates the pass transistor (A7A2-Q2). With the pass transistor activated, the battery voltage will again appear on the input to the voltage sensing circuits. If the voltage level exceeds the +24VDC threshold level for zener diode A7A1A12-CR5, the zener diode will conduct, keeping the transistors in the cut-off circuit activated. If the voltage level remain below +24VDC, the circuit will function as explained above and remove the battery power from the power supply circuit. The low voltage cut-off circuit function is to prevent the battery from being permanently damaged by a complete discharge and in addition prevents operation of the receiver under low voltage conditions which could result in inaccurate readings.

2.2.16.3 BATTERY CHARGE CIRCUIT

The BAT-25R battery pack for the CPR-25 comprises twenty-four four ampere-hour 1.2V nickle-cadminum cells. This type of cell was selected since it maintains an almost constant output voltage level until they are very deeply discharged. Another characteristic of nickel-cadminum is that the charge rate determines the maximum capacity of the charged cell, thus the higher the charge rate the greater the stored capacity of the cell. However once the cell is charged, the heat generated by the charge circuit could permanently damage the battery cells. Thus the ideal charge circuit would permit the fastest possible charge rate while at the same time preventing overcharging of the battery cells.

The BAT-25R Battery Assembly (A9) contains two thermistors which are an integral part of the battery charging circuit. One thermistor is attached to the battery assembly case, while the second thermistor is located in the center of the battery cell assembly. The purpose of the thermistors is to monitor the battery temperature differential between the battery cells and the battery case (ambient condition), with an increase in the temperature differential denoting a full battery charge condition. The thermistors are part of the battery charging circuit, located on the Battery Charger and Low Voltage Cut-Off board, and comprises the bottom legs of a bridge circuit driving an operational amplifier (A7A1A12-U1). The top legs of the bridge circuit are comprised of fixed resistors plus a screwdriver adjustment which sets the temperature differential at which the battery charger circuit will operate. The output of the operational amplifier drives a current source that determines the maximum battery charge rate. When a receiver with a discharged battery is connected to an AC power source and turned off, the current source will charge the battery at a rate of 350 ma until it approaches a full charge. As the battery approaches its full charge capacity, internal heating occurs which causes an imbalance in the bridge circuit driving the operational amplifier due to thermistor resistance changes. These imbalances cause the operational amplifier to turn off the current source and the charge current to the battery.

When the battery cools down, the charge circuit will be reactivated until the temperature rise in the battery is controlled to approximately 1.5°C, this charge cycle can continue indefinitely without damaging the battery cells.

2.2.16.4 BATTERY CHARGE INDICATIONS

The LED Battery Charge Light, located on the front panel under the meter, is activated under the following conditions:

A. CPR-25 connected to an AC power source, with the unit Turned Off. Under these conditions, the optional battery is being charged at its maximum charge rate.

B. CPR-25 connected to an AC power source, with the unit Turned On. Under these conditions, the optional battery is not being utilized and is receiving a trickle charge.

C. With no optional battery installed, the LED Battery Charge Light will indicate whether the unit is connected to an AC power source. When the receiver is activated and the charge light is off, this indicates that the receiver is operating with the optional battery as its sole power source.

The Battery Test switch (A1S1) is located on the receiver's front panel under the Battery Charge Light. When utilized, it connects the front panel meter across the battery via a zener diode for voltage offset and overload protection plus a multiplying resistor. The approximate status of the battery charge is indicated on the bottom scale of the meter as being in one of two conditions: LOW or OPERATE. A reading in the "LOW" portion of the scale indicates that the battery has an insufficient level of charge for successful receiver operations. The battery under these conditions, should either be replaced with a fully-charged battery or allowed to charge fully over a period of 12 to 16 hours. A reading in the "OPERATE" portion of the scale indicates that the battery has a sufficient level of charge for proper operation of the receiver. A valid reading of the battery charge conditions can only be obtained with the receiver disconnected from the AC power source and turned on.

2.2.16.5 HIGH VOLTAGE CONVERTER (A6A4)

The HV Converter is located within the Power Supply Assembly (A6) and converts the regulated RAW supply to approximately 150VDC by utilizing a class "C" oscillator circuit operating at 200kHz. The resultant high voltage output is supplied to the Tuning Regulator board (A2A16A2) and the I.G. Calibrator Assembly (A2A17) for use by their respective circuitry. The circuitry for the HV converter assembly is located within a double-sealed module for shielding and filtering purposes.

2.2.17 TUNING VOLTAGE-SWEEP CIRCUITRY

2.2.17.1 GENERAL

The TUNING VOLTAGE-SWEEP Circuitry of the CPR-25 comprises the following four P.C. boards:

A. The SWEEP CONTROL (A1A5) and SWEEP (A1A6) boards which are located behind the front panel analog meter.

B. The TUNING REGULATOR (A2A16A2) board located within the RF Preselector (A2) Assembly.

C. The AUTO SWEEP/AUDIO AMPLIFIER (A7A1A6) board which is located in the lower compartment Card Guide Assembly (A7A1).

The CPR-25 utilizes varactor diode circuitry for tuning the receiver over the frequency range of the band segment selected. The capacitance of the varactor diode circuitry is varied by a high level, 0 to +100VDC, varactor tuning voltage produced by the Tuning Regulator board (A2A16A2). The high level varactor tuning voltage is shaped by a non-linear amplifier circuit to approximate a linear tune voltage versus frequency curve. The amplifier is driven by a low voltage, 0 to +1.5VDC, tuning signal produced by the Sweep Control board (A1A5). The output voltage shaping is required since the varactor tune voltage versus varactor capacitance is a non-linear function while the low voltage tuning signal versus frequency is a linear function. In addition to producing the low voltage tuning signal the Sweep Control board (A1A5) also determines the sweep mode for the receiver, while the linear ramp voltage required for frequency sweeping is generated by the Sweep board (A1A6). The auto sweep circuitry is utilized when making X-Y recorder plots to permit accurate peak level responses to be recorded while fast sweep speeds permit the scan to be accomplished in a relatively short time.

2.2.17.1.1 CPR-25 TUNING MODES

The tuning-sweep circuitry of the CPR-25 is controlled by the following modes of operation:

A. Local/Manual Tuning Mode: The frequency of the CPR-25 is controlled by the front panel COARSE TUNE and FINE TUNE Control settings. An AFC circuit, utilizing the output of the FM Discriminator circuit (A3A3), can be activated to lock in a tuned signal.

B. Remote Tuning Mode: The frequency of the CPR-25 is set by an external 0 to +1.5VDC voltage applied via the rear panel Remote Connector A7J7.

C. Local/Sweep Tuning Mode: This mode of CPR-25 tuning is utilized in one of three ways:

   1. Spectrum Sweep – X-Y Recorder: A frequency scan over the frequency range of the selected band segment is initiated by pressing the SWEEP START switch. The sweep time per band (sweep rate) is variable from 10 to 1000 seconds by means of the SWEEP TIME switch (10 and 100 second positions) and SWEEP MULTIPLIER Control (X1 to X10). Each sweep cycle is nonrepetitive; thus each new sweep cycle must be initiated by pressing the SWEEP START switch. The X (sweep voltage) and Y (signal level) outputs plus pen control logic commands are present on the rear panel Plotter Connector A7J6.
   2. Spectrum Sweep – Oscilloscope Presentation: When the SWEEP TIME switch is set to either the 0.1 or 1.0 second positions, the sweep cycle is continuously initiated and repeated. In conjunction with the SWEEP MULTIPLIER Control, the sweep time is variable from 0.1 to 10 seconds. When an ordinary oscilloscope is connected to the rear panel Horizontal (X sweep), Vertical (Y Video), and Blanking BNC connectors; a tracking preselector spectrum analyzer will result. A marker notch, added to the horizontal output, indicates the frequency settings of the front panel manual tune controls (COARSE & FINE). This function is utilized to determine the frequency of an observed signal response on the oscilloscope.
   3. Dispersion Sweep: This sweep mode is primarily intended for utilization with an external oscilloscope but is also suitable for use with an X-Y recorder. It allows a selected portion of a band segment's frequency range to be swept and the resulting sweep cycle to be displayed in an expanded format on the oscilloscope CRT or X-Y recorder plot. The DISPERSION Control sets the percentage of the band segment frequency range to be swept from 1% (MIN) to 100% (MAX), with the center frequency of the dispersion sweep set by the front panel manual tune controls (COARSE & FINE). The marker notch will thus set the center frequency.

D. Auto Sweep Circuit: The Auto Sweep circuit, when activated, slows down the basic sweep rate (set by the SWEEP TIME switch and SWEEP MULTIPLIER Control) whenever a signal input is detected to ensure accurate measurement of peak levels. The circuit's function is to permit accurate plotting of the slow response detection circuits (CARRIER, RMS, CISPR) on an X-Y recorder, but is also useable in the other sweep modes of the receiver.

2.2.17.2 SWEEP CONTROL BOARD (A1A5) (SEE FIG. 6.31)

The Sweep Control board (A1A5) processes the input tuning signals to produce the various tuning modes for the CPR-25. The linear ramp voltage required for frequency sweeping is generated by the SWEEP board (A1A6) described in 2.2.17.3. In the following discussion, the function and operation of the Sweep Control board is described for the different tuning modes and outputs.

A. Local/Manual Tuning Mode: In this mode a voltage level of 1.5VDC is applied to one side of the front panel COARSE TUNE Control (A1A1-R8), a 10 turn precision potentiometer. The DC voltage level is produced on the Sweep Control board and can be adjusted by means of A1A5-R7 (TUNING VOLTAGE SUPPLY – screwdriver adjustment). The other side of the potentiometer is connected to ground, with the arm of the potentiometer connected to the non-inverting input of A1A5-U3. This is a FET input differential amplifier having a gain of 4 which results in an output of 0 to +6VDC for an input of 0 to +1.5VDC. In addition, two other inputs are also applied to the non-inverting input of A1A5-U3. One input is received from the arm of the front panel FINE TUNE Control which applies a 0 to +12VDC input level to the non-inverting input via a 22 megohm resistor (A1A5-R28). This results in a gain of 1/500 with a total range effect on the 0 to +6VDC output voltage of approximately 0.5%. The second input is received from the front panel AFC switch (A1S14) which switches the AFC voltage from the FM DISCRIMINATOR circuit to the non-inverting input via a resistance of 4.4 megohms. The error voltage from the Discriminator circuitry offsets the 0 to +6VDC output to keep the receiver tuned to the selected frequency. The low end of the frequency tuning range is calibrated by A1A5-R34 (MANUAL TUNE ZERO — screwdriver adjustment), while the high end of the frequency tuning range is calibrated by A1A5-R7 (TUNING VOLTAGE SUPPLY — screwdriver adjustment).

The output of A1A5-U3 is applied via the front panel MANUAL/SWEEP switch (A1S13) and the LOCAL/REMOTE switch (A1S3) to the input of the Tuning Buffer amplifier A1A5-U1B. Resistors A1R9 and A1R10 connected between the MANUAL SWEEP and LOCAL/REMOTE switches comprise part of a voltage divider network which divides down the 0 to +6VDC voltage level by a fourth to 0 to 1.5VDC. Since A1A5-U1B is a differential amplifier having basically unity gain, its output is 0 to +1.5VDC which is the low voltage tuning signal applied to the Tuning Regulator board (A2A16A2).

In order to reduce the common mode pickup which can cause FM'ing of the tuning signal, all interconnections between the various PC boards and controls are either shielded pairs or coaxial cable. In addition, the differential inputs of both A1A5-U3 and U1B also help to keep common mode pickup to a minimum

B. Remote Tuning Mode: For the REMOTE position of the LOCAL/REMOTE switch, an external 0 to +1.5VDC tuning signal is applied via the Remote Connector A7J7 (PINS C & J) to the differential input of A1A5-U1B. Again, as in the Local/Manual Tuning Mode, the input ground side of A1A5-1UB is referenced to the external tuning source minimizing common mode pickup.

C. Spectrum Sweep Mode: In the Spectrum Sweep Mode, the 0 to +6VDC sweep voltage ramp generated by the Sweep board (A1A6) is applied via the SPECTRUM/DISPERSION Switch (A1S18), MANUAL/SWEEP switch (A1S13), and the LOCAL/REMOTE switch (A1S3) to the differential input of A1A5-U1B. As described for the Local/Manual Tuning Mode, a voltage divider comprising A1R9 and A1R10 divides down the sweep voltage from 0 to +6VDC to 0 to +1.5VDC. Thus the output of unity gain amplifier A1A5-U1B will be a 0 to +1.5VDC sweep voltage ramp.

D. Dispersion Sweep Mode: In the Dispersion Sweep Mode, the 0 to +6VDC sweep voltage ramp (from Sweep board A1A6) is applied via the MANUAL/SWEEP switch (A1S13) to the inverting input of A1A5-U1A. This is a unity gain amplifier having a DC offset voltage which is adjustable by means of A1A5-R2 (SWEEP OFFSET — screwdriver adjustment). A1A5-R2 is normally adjusted to produce an amplifier output of +3.0 to -3.0VDC for the sweep voltage input of 0 to +6VDC. This inverted symmetrical sweep voltage is applied to one side of the front panel DISPERSION Control (A1R5) with the other side connected via a 47 ohm resistor to ground. The potentiometer arm is connected via a unity gain buffer amplifier A1A5-U2A to the inverting input of the Dispersion Adder A1A5-U2B. This is a unity gain amplifier whose non-inverting input is connected to the output of A1A5-U3 (MANUAL TUNE BUFFER). The output of the Adder Amplifier A1A5-U2B is a positive going tuning sweep voltage whose output swing is equal to that portion of the sweep selected by the DISPERSION Control, 100% to 0.5%, and which has a mean DC offset equal to the DC level set by the COARSE TUNING Control.

The two inputs noted above can produce the following outputs:

1. With a maximum Dispersion sweep (+3VDC to -3VDC) from A1A5-U2A and a 0VDC tuning voltage input from A1A5-U3, the output swing for A1A5-U2B would be from -3VDC to +3VDC.
2. With the COARSE TUNING Control set for maximum (+6VDC), the output swing for A1A5-U2B would be from +3VDC to +9VDC.

   A negative output or one greater than +6VDC cannot be tolerated since the tuning range of the receiver would be exceeded. For this reason the output of A1A5-U2B is applied to the Sweep board (A1A6) (See Fig. 6.32), where it is "OR"ed with the linear ramp voltage (generated by the Sweep board) through four diodes

A1A6-CR4, CR5, CR6 and CR7 located on the inputs to the four sweep comparators (see Section 2.2.17.3 for a full description of the Sweep board operation).

If the output of amplifier A1A5-U2B starts to exceed the +6VDC limit, the resulting feedback to the Sweep board through A1A6-CR7 causes the PEN DOWN and RETRACE START comparators to switch decreasing the sweep amplitude. If the output of Amplifier A1A5-U2B starts to go negative, the feedback to the Sweep board through A1A6-CR6 causes the PEN UP AND RETRACE STOP comparators to switch forcing the sweep to start at the same positive DC voltage level rather than ground.

E. Marker Function: The Marker Function is utilized during the Spectrum Sweep- Oscilloscope Presentation Mode of Operation as a means of determining the frequency of a response rated on the CRT Display. The Marker circuitry generates a marker function (notch) which is added to the video signal (X) output to the oscilloscope. The positioning of the marker notch on the frequency sweep of the CRT is controlled by the front panel COARSE TUNING Control.

Two comparators, A1A5-U4A & U4B located on the Sweep Control board (A1A5), are used to generate the marker function. The non-inverting input of A1A5-U4A is connected through A1A5-R38 to the sweep voltage source via the front panel MANUAL/SWEEP switch (A1S13). The inverting input of A1A5-U4A is connected via A1A5-R40 to the output of A1A5-U3 (MANUAL TUNE VOLTAGE). The other comparator, A1A5-U4B utilizes the same inputs as A1A5-U4A but in reverse order from A1A5-U4A.

During a sweep cycle the output of A1A5-U4A will be positive until the sweep voltage exceeds the manual tune voltage, at which point the output of A1A5-U4A will swing negative. Since the connections to A1A5-U4B are reversed, the output will start negative and swing positive. An OR gate composed of diodes A1A5-CR2 & CR3 will pass only the negative outputs of the comparators. Simultaneous switching of both comparators, however, would not generate the required marker function since the output of the OR gate would be negative. Thus a positive DC bias supplied by A1A5-R35 & CR1 causes A1A5-U4A to switch just before the sweep voltage exceeds the manual tune voltage and A1A5-U4B to switch just after. Therefore, the output of the OR gate will be 0VDC during the interval between each comparator switching and negative the remainder of the time. This signal, attenuated by resistors A1A5-R47 & R48, is applied to the non-inverting input of A1A5-U5B (MARKER ADDER); while the video signal from the Log board (A7A1A4) is applied to the non-inverting input of A1A5-U5B. The output of A1A5-U5B, a unity gain amplifier, is a video signal containing a negative going notch equivalent to the frequency setting of the front panel COARSE TUNING Control. This output is applied to the rear panel oscilloscope Vertical Output Connector A7J3.

F. Horizontal (X) Output: A1A5-U5A on the Sweep Control board is a unity gain buffer amplifier whose output drives either the horizontal (X) output for the external oscilloscope or the X output to an external X-Y recorder.

The input to the buffer amplifier A1A5-U5A is the 0 to +6VDC tuning voltage (either sweep or manual depending on the tuning mode selected), while the output is a buffered 0 to +6VDC signal applied directly to the rear panel Oscilloscope Horizontal (X) Output Connector A7J4. The output of A1A5-U5A is also divided by a voltage divider, comprising A1A5-R58 & R59, to provide a 0 to +1.5VDC output required to drive the X axis of an external X-Y recorder.

2.2.17.3 SWEEP BOARD (A1A6)
(SEE FIG. 6.32)

The Sweep board (A1A6) generates the linear ramp voltage required for frequency sweeping across a selected band segment. The active integrator circuit comprises the following:

A. A FET input operational amplifier — A1A6-U2.

B. A quad FET switch package — A1A6-U1.

C. Integrating capacitors A1A6-C1 thru C4 which are selected via the FET switches of A1A6-U1. The individual FET switches included as part of A1A6-U1 are activated by the position of the front panel SWEEP TIME switch (A1S17).

D. Current source resistor A1A6-R60.

Current source resistor A1A6-R60 is connected between the arm of the front panel SWEEP MUL-

TIPLIER Control (A1R4) and the inverting input of A1A6-U2. Since the non-inverting input of differential amplifier A1A6-U2 is at ground potential, this sets the voltage potential on the inverting input at or near 0.00VDC (ground). The current through A1A6-R60 is thus dependent only on the voltage applied to it via the SWEEP MULTIPLIER Control. The resulting constant current through A1A6-R60 charges the selected integrating capacitor linearly and since the integrating capacitor is connected between the inverting input and the output of A1A6-U2, the output of A1A6-U2 is the charge on the integrating capacitor. Therefore as a positive DC voltage is applied to A1A6-R60, a linear negative going ramp will appear at the output of A1A6-U2. The voltage charge rate on the output of A1A6-U2 is dependent only on the value of capacitor selected and the DC voltage applied to A1A6-R60 from the SWEEP MULTIPLIER Control.

The output of A1A6-U2 is applied to the inverting input of A1A6-U3B, a unity gain inverting amplifier. The output of A1A6-U3B, a positive going linear ramp, is the sweep tuning voltage for the receiver. The output of A1A6-U3B is connected via diodes A1A6-CR4 & CR5 to the input circuitry of four comparators. A second input to the comparators is via diodes A1A6-CR6 & CR7 from A1A6-K of the Sweep board. A1A6-CR4 & CR6 and CR5 & CR7 form a pair of "OR" gates which allow the comparators to be controlled by whichever input, A1A6-U3B output or A1A6-K input, is larger. For the Spectrum Sweep Mode, A1A6-K is held low and only the output of A1A6-U3B controls the comparators. For the Dispersion Sweep Mode, under the conditions stated in 2.2.17.2-D, the input from A1A6-K will exceed the output of A1A6-U3B and thus control the comparators. The four comparator circuits control the starting and ending points of the sweep cycle, generate a PEN DOWN and UP logic command signals, plus an oscilloscope blanking signal.

The inverting input (reference) of A1A6-U4B (PEN DOWN comparator) is biased at approximately +0.6VDC by the voltage drop across A1A6-CR8. The non-inverting input of A1A6-U4B is similarly biased by the drop across A1A6-CR4 so that the non-inverting input of A1A6-U4B will be 0.6VDC more positive than the output of A1A6-U3B. As a result, the switching point for A1A6-U4B will be at 0VDC as referenced to the output of A1A6-U3B. The non-inverting input to A1A6-U3A (RETRACE STOP Comparator) is biased slightly more negative than A1A6-U3B by a voltage divider comprising resistors A1A6-R18 & R20. Thus the switching point for A1A6-U3A will be slightly negative as referenced to the output of A1A6-U3B. The bias on the non-inverting input of A1A6-U4A (PEN UP Comparator) is set by A1A6-R29 (SWEEP AMPLITUDE SET — screwdriver adjustment) in conjunction with a voltage divider comprised of resistors A1A6-R28 & R31.

Since the sweep voltage amplitude is required to be approximately +6.0VDC on the output of A1A6-U3B, the DC bias to the non-inverting input of A1A6-U4A is usually set at +6.6VDC by A1A6-R29 due to the nominal 0.6VDC drop across diode A1A6-CR5. Adjusting A1A6-R29 will also set the DC bias on the non-inverting input to A1A6-U5A (RETRACE START Comparator) which will be at a slightly higher level as compared to A1A6-U4A.

A. Repetitive Sweep Cycle: For repetitive sweep mode conditions, the comparator circuitry operates in the following manner:

Assume that a sweep cycle has been initiated in the Spectrum Sweep Mode utilizing either of the two oscilloscope sweep speed (0.1 or 1.0 seconds) settings. (Selectable by means of the front panel SWEEP TIME switch A1S17). A positive going ramp will be initiated at the output of A1A6-U3B. This causes the output of A1A6-U3A (RETRACE STOP Comparator) to swing negative since the ramp level at its inverting input is more positive than the DC bias reference on the non-inverting input. This will back bias diode A1A6-CR9 on the output of A1A6-U3A. In a like manner the output of A1A6-U4B (PEN DOWN Comparator) will be positive because the ramp voltage is applied to its non-inverting input, which will back bias diode A1A6-CR10 on its output.

The output of A1A6-U4A (PEN UP Comparator) is positive since the ramp voltage applied to its inverting input is lower than the +6VDC bias applied to its non-inverting input. This will back bias diode A1A6-CR11 on the output of A1A6-U4A. The output of A1A6-U5A (RETRACE START Comparator) is also positive due to the fact that the DC bias level to its non-inverting input is higher than the ramp level applied to its inverting input. This will back bias diode A1A6-CR12 on the output of A1A6-U5A.

When the ramp voltage at the output of A1A6-U3B exceeds +6 Volts, the output of A1A6-U4A (PEN UP Comparator) will swing negative forward biasing diode A1A6-CR11. The resultant negative input applied to the non-inverting input of A1A6-U6B (BLANKING AMPLIFIER) causes the output of A1A6-U6B to swing negative. The output is normally held positive by means of a positive bias applied via resistor A1A6-R51 and the resultant positive feedback via resistor A1A6-R52. The output of A1A6-U6B, when coupled directly to the BLANKING output — A1A6-X via resistor A1A6-R61, provides a negative blanking signal for an external oscilloscope. The output of A1A6-U6B is also inverted by A1A6-Q2 to provide a PEN UP logic command signal for an external X-Y recorder. For those oscilloscopes which require a positive blanking signal, the output of A1A6-Q2 is coupled to the Blanking output (A1A6-X) again via resistor A1A6-R61 (utilizing an internal jumper).

When the increasingly positive ramp voltage exceeds the DC bias applied to A1A6-U5A (RETRACE START Comparator) its output will swing negative. This will forward bias diode A1A6-CR12 which applies a negative voltage to the non-inverting input of A1A6-U6A (RETRACE GATE). During the course of the sweep cycle, A1A6-U6A has been latched positive due to the positive feedback via resistor A1A6-R49, the negative input from A1A6-U5A will now cause A1A6-U6A to become latched negative. The negative output of A1A6-U6A is coupled via diode A1A6-CR3 and resistor A1A6-R5 back to the integrator circuit which override the positive current supplied via current source resistor A1A6-R60 and initiates a rapid sweep retrace. The negative output from A1A6-U6A is also coupled via diode A1A6-CR15 to A1A6-U6B to maintain the BLANKING/PEN UP output logic command.

Once the retrace sweep is initiated the output of A1A6-U5A (RETRACE START Comparator) will swing positive, but since diode A1A6-CR12 is again back biased it will not affect the latched up status of A1A6-U6A (RETRACE GATE). The output of A1A6-U4A (PEN UP Comparator) will also swing positive and back bias diode A1A6-CR11. This has no effect on the BLANKING/PEN command logic output since A1A6-U6B (BLANKING) is being maintained in its BLANKING/PEN UP state by the negative output from A1A6-U6A (RETRACE GATE).

As the retrace sweep continues and the output of A1A6-U3B crosses the zero point, the output of A1A6-U4B (PEN DOWN Comparator) will swing negative and forward bias diode A1A6-CR10. The negative output from A1A6-U4B is added to the negative output from A1A6-U6A but has no effect on the output of A1A6-U6B at this point in the retrace cycle.

Finally when the output of A1A6-U3B swings negative, diode A1A6-CR4 becomes forward biased applying the output of A1A6-U3B to the inverting input of A1A6-U3A (RETRACE STOP Comparator). This causes the output of A1A6-U3A to swing positive and forward bias diode A1A6-CR4. The output of A1A6-U3A is then applied to the non-inverting input of A1A6-U6A and latches the retrace gate positive. Diode A1A6-CR3 is again back biased which allows a new sweep ramp to be initiated by the integrating circuit. Even though the output of A1A6-U6A is latched positive thus back biasing diode A1A6-CR15, the output of A1A6-U6B remains negative due to the negative input from A1A6-U4B (PEN DOWN Comparator).

When the newly initiated sweep ramp causes the output of A1A6-U3B to cross the zero point and go positive, the output of A1A6-U4B (as explained earlier) will also swing positive and back bias diode A1A6-CR10. This removes the negative output applied to the non-inverting input of A1A6-U6B, the positive bias applied via resistor A1A6-R51 then causes the output of A1A6-U6B to swing positive. An UNBLANK/PEN DOWN logic command signal will be the result as one sweep cycle is completed and another initiated.

B. Single Sweep Cycle: The preceding discussion (2.2.17.3A) described the repetitive sweep cycle utilized for use with an external oscilloscope in the 0.1 and 1.0 second positions of the SWEEP TIME switch (A1S17). The slower sweep times of 10 and 100 seconds utilized for use with an X-Y recorder require a single sweep capability and this function is performed by A1A6-U5B (SWEEP START LATCH).

Diodes A1A6-CR1 & CR2 form an "OR" gate which for the oscilloscope sweep times (0.1 & 1.0 seconds) latches the output of A1A6-U5B positive by biasing its non-inverting input positive. When either of the two sweep times (10 or 100 seconds) for an X-Y recorder is selected, the resultant low on A1A6-B or D enables A1A6-U5B by forcing one end of resistor A1A6-R40 low. With no sweep cycle initiated the output of A1A6-U5B will be latched negative due to the negative feedback around A1A6-U5B. The negative output forward biases diode A1A6-CR14 coupling the negative output to the non-inverting input of A1A6-U6A (RETRACE GATE) which latches its output negative (retrace logic state). The negative output of A1A6-U5B also allows A1A6-U1 pin 15 to be held low which activates a FET switch connecting resistor A1A6-R6 between the output and inverting input of A1A6-U2 (SWEEP GENERATOR). This action shorts out the integrating capacitors and holds the output of A1A6-U3B at 0VDC.

To initiate a sweep cycle the front panel SWEEP START switch (A1S15) is momentarily pressed which couples a positive input to the non-inverting input of A1A6-U5B and causes its output to swing positive. This causes diode A1A6-CR14 to become back biased removing the negative bias latching the output of A1A6-U6A negative. However, due to the negative output from A1A6-U3A (RETRACE STOP) the output of A1A6-U6A will remain in a negative state. The positive output also forward biases diode A1A6-CR13 which forces A1A6-U1 pin 15 to go high which deactivates the FET switch. This removes resistor A1A6-R6 as a short circuit between the input and output of A1A6 U2. A short retrace period follows, while the output of A1A6-U3B goes from 0VDC to a slightly negative voltage. This causes the output of A1A6-U3A to swing positive which in turn causes the output of A1A6-U6A to swing positive thus initiating the positive sweep voltage ramp.

The sweep and retrace cycle proceeds as described above in 2.2.17.3A until the output of A1A6-U4B (PEN DOWN Comparator) swing negative during retrace. The negative pulse, coupled via A1A6-C9, R49 & R43, latches the output of A1A6-U5B negative. This latches up A1A6-U6A and forces A1A6-U1 Pin 15 to go high — activating the FET switch placing A1A6-R6 as a short between the input and output of the A1A6-U2. This halts the sweep circuitry operation until the front panel SWEEP START switch is again pressed.

2.2.17.4 TUNING REGULATOR BOARD (A2A16A2) (SEE FIG. 6.33)

This plug-in printed circuit board is located in the main shielded compartment in a card guide bracket attached to the side of the power supply compartment. Its function is to amplify and shape the 0 to 1.5V tuning voltage signal from the Sweep/Tune board A1P1, resulting in a nonlinear 0 to 100V varactor tuning output voltage. As the voltage vs. frequency characteristic of the varactors is very non-linear, the shaping is required to obtain approximately linear input-tuning-voltage vs. frequency characteristics.

The 0 to 1.5V input tuning voltage is applied to the gate of FET Q5 via pin 22 of the board. Q5 and Q6 and current source Q8 provide a high impedance differential input for operational amplifier U1. The output of U1 is referenced to the +150 volt supply by Q2. This 150V supply from the high voltage converter A5A1 enters the board at pin 5. Q4 is an emitter follower driven by U2 via CR1. The output of Q4 (Pin 3 of the board) is the varactor tuning voltage. Pin 3 and Pin 4 are internally connected together. The negative feedback circuit for the amplifier consistsof R15, biased diodes CR5-CR9, and resistors R18-R28. The gain of the amplifier circuit is established by the characteristics of this feed-back network. Each of the shaping diodes (CR5-CR9) is individually back-biased at different levels by a pair of biasing resistors in its cathode circuit. Q7 is a voltage regulator supplying the bias networks.

The feed-back loop forces the voltage at the gate of Q6 to be equal to the input voltage to Q5. The amplitude of this voltage and the biasing networks for shaping diodes CR5-CR9 determine the circuit gain. With an Ov tuning level in, all diodes will be back-biased and the overall gain will be set by a resistive network consisting of R15, R37, R1 and R17. R36, by applying a variable DC bias to Q6, is used as a zero adjustment. If the input tuning voltage is increased until it exceeds the back bias of CR5, supplied by R18 and R20, CR5 will conduct. The resulting increase in gain is determined by the parallel value of R18 and R19. As the input tuning voltage is further increased towards 1.5V, CR6 through CR9 will be turned on in sequence, as the tuning voltage exceeds their respective individual biases. The circuit gain is further increased as each diode is turned on. The resultant non-linear gain-vs-input characteristics shape the varactor tuning voltage output to provide approximately linear tuning voltage vs. frequency. Emitter follower Q3 allows the varactor tuning line to be discharged quickly when the receiver is being swept remotely. Zener diode CR2 (105V) prevents the tuning line from becoming so positive that varactor damage could result. Diodes CR3 and CR4 protect U1 from transients.

SECTION III
Operating Instructions

3.1 GENERAL

This section provides information and instructions for the operation of the Interference Analyzer Model CPR-25.

CAUTION

Read all information in this section before attempting operation. Improper operation may cause costly damage to the instrument.

3.2 OPERATIONAL PRECAUTIONS

3.2.1 POWER SOURCE SWITCH

An AC power source switch is located on the power supply panel which in turn is located on the rear of the CPR-25. Check that the switch is set according to the A.C. power source being utilized. Operation on a 230VAC line with the switch set to the 115VAC position can cause extensive circuit damage.

3.2.2 MANUAL/SWEEP SWITCH

The Manual/Sweep must be in the manual position to permit local operation of the frequency control dial.

3.2.3 LOCAL/REMOTE SWITCH

The Local/Remote switch must be in the Local position for manual operations.

3.2.4 INPUT VOLTAGE

Damage to the input attenuator may result if signals larger than 5 volts rms are applied continuously. Pulse signals must be less than 0.5 watt average power and 500 watts peak power.

3.2.5 OFF FREQUENCY SIGNALS

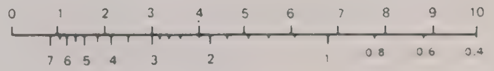
Any superhet receiver such as the CPR-25 may generate spurious signals when one or more high-level signals are applied to its input. The exact amplitude of the resultant signals is dependent on so many variables that specific prediction is not feasible.

Despite the many design precautions taken to minimize such responses, they will appear under some conditions. One method of determining whether a signal is spurious or not is to increase the input attenuation by 20dB and note which signals drop by that amount. Any signals decreasing by more or less than 20dB are spurious. A useful aid in determination of spurious signal responses is to utilize the spectrum analyzer capability of the instrument.

3.2.6 AMPLITUDE ACCURACY

For signals close to the noise level of the instrument, a correction must be made. Use the Correction Factor Scale below.

DB METER READING (ABOVE NOISE)



CORRECTION FACTOR (SUBTRACT)

Top Scale is that increase in dB in meter reading over noise level when input signal is applied.

Bottom Scale is that amount in dB to be subtracted from total meter reading to find actual signal level.

EXAMPLE:

Internal Noise	-30dB (above 1uV)
Meter indication with signal applied	-25dB
Increase in meter reading (30-25)	5dB
From Scale: amount to be subtracted	1.65dB

Actual signal level equals:
(-25) - 1.65=26.65dB (above 1 uV)

The CPR-25 cannot be satisfactorily calibrated when the AFC is in operation. Carrier can be measured with AFC on, only if the signal has been peaked on the meter using the FINE TUNE control.

3.3 CONTROL FUNCTIONS

All controls for operation and utilization of the CPR-25 Interference Analyzer capabilities are located on the front panel. The location of each individual control and indicator is shown in Figure 3-1 and described in the following paragraphs.

3.3.1 ATTENUATOR

The attenuator adds attenuation to the RF and IF circuits in 10dB increments for a total attenuation range of 80dB. Table 3-1 lists the amount of attenuation used.

TABLE 3-1

RF & IF ATTENUATION

Total Indicated Attenuation	IF Attenuation	RF Attenuation
0 dB	0 dB	0 dB
10 dB	10 dB	0 dB
20 dB	10 dB	10 dB
30 dB	10 dB	20 dB
40 dB	10 dB	30 dB
50 dB	10 dB	40 dB
60 dB	10 dB	50 dB
70 dB	10 dB	60 dB
80 dB	10 dB	70 dB

3.3.1.1 ATTENUATION CONTROL

Utilizes two pushbutton switches; one to increase, the other to decrease the total attenuation of the unit.

3.3.1.2 ATTENUATION INDICATOR

A four digit Liquid Crystal Display readout which indicates the total amount of attenuation to be algebraically added to the meter reading. The Attenuation sign is normally plus except for Bands 1-3 where under certain conditions, linear position of the detector output switch, the sign may be minus. An overload condition within the instrument is indicated by the display flashing the letters O & L.

3.3.2 FREQUENCY CONTROL

3.3.2.1 TUNING CONTROL (COARSE)

Main control utilized in manually tuning the instrument to the frequency desired.

3.3.2.2 TUNING CONTROL (FINE)

A vernier control whose range covers approximately one percent of the frequency range segment being utilized.

3.3.2.3 FREQUENCY DISPLAY

A six digit Liquid Crystal Display readout which indicates the frequency (in MHz) the instrument is tuned to. The accuracy is ± 0.1% over the entire frequency range of 10kHz to 1000MHz.

3.3.2.4 DISPLAY ON/OFF SWITCH

A two position toggle switch which enables the user to turn the Frequency Display off. Normally used to conserve power when an optional battery pack is being utilized as the sole power source for the instrument. No other unit functions are affected by this operation.

3.3.2.5 MANUAL/SWEEP SWITCH

A two position toggle switch which determines whether frequency tuning is to be done manually or swept automatically.

3.3.2.6 FREQUENCY RANGE SWITCHES

Dual pushbutton switches which are utilized to select one of fifteen internal band segments for the frequency range desired.

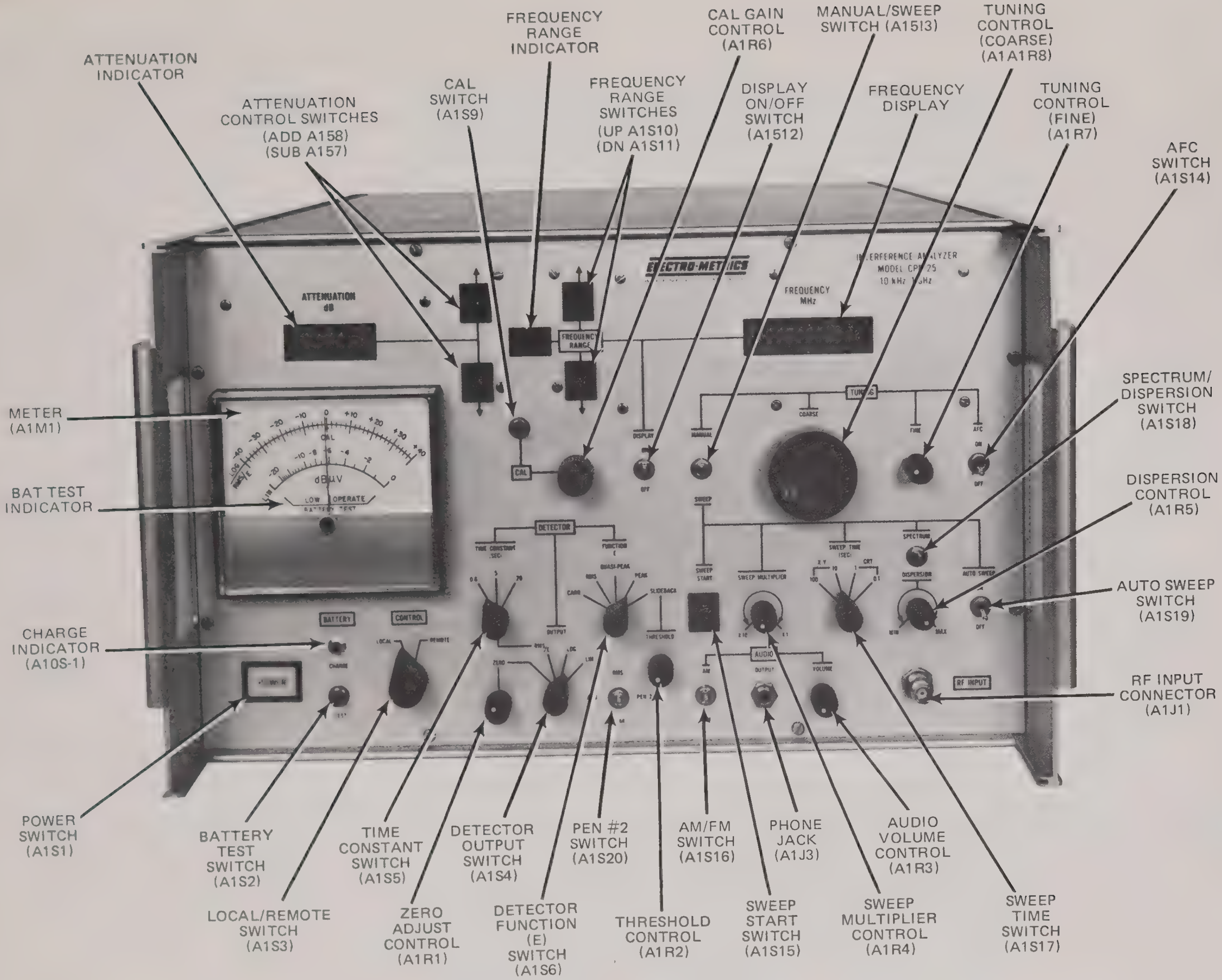

ATTENUATION INDICATOR
ATTENUATION CONTROL SWITCHES (ADD A158) (SUB A157)
CAL SWITCH (A1S9)
FREQUENCY RANGE INDICATOR
FREQUENCY RANGE SWITCHES (UP A1S10) (DN A1S11)
CAL GAIN CONTROL (A1R6)
DISPLAY ON/OFF SWITCH (A1512)
MANUAL/SWEEP SWITCH (A15I3)
FREQUENCY DISPLAY
TUNING CONTROL (COARSE) (A1A1R8)
TUNING CONTROL (FINE) (A1R7)
AFC SWITCH (A1S14)
SPECTRUM/ DISPERSION SWITCH (A1S18)
DISPERSION CONTROL (A1R5)
AUTO SWEEP SWITCH (A1S19)
RF INPUT CONNECTOR (A1J1)
METER (A1M1)
BAT TEST INDICATOR
CHARGE INDICATOR (A10S-1)
POWER SWITCH (A1S1)
BATTERY TEST SWITCH (A1S2)
LOCAL/REMOTE SWITCH (A1S3)
TIME CONSTANT SWITCH (A1S5)
ZERO ADJUST CONTROL (A1R1)
DETECTOR OUTPUT SWITCH (A1S4)
DETECTOR FUNCTION (E) SWITCH (A1S6)
PEN #2 SWITCH (A1S20)
THRESHOLD CONTROL (A1R2)
AM/FM SWITCH (A1S16)
SWEEP START SWITCH (A1S15)
PHONE JACK (A1J3)
SWEEP MULTIPLIER CONTROL (A1R4)
AUDIO VOLUME CONTROL (A1R3)
SWEEP TIME SWITCH (A1S17)
ELECTRO-METRICS
INTERFERENCE ANALYZER MODEL CPR-25 10 kHz 1 GHz
ATTENUATION dB
FREQUENCY MHz
FREQUENCY RANGE
TUNING
COARSE
FINE
AFC
ON
OFF
DISPLAY
MANUAL
SWEEP
CAL
DETECTOR
TIME CONSTANT (SEC)
FUNCTION E
QUASI-PEAK
PEAK
SLIDEBACK
CARR
RMS
OUTPUT
THRESHOLD
SWEEP START
SWEEP MULTIPLIER
SWEEP TIME (SEC)
SPECTRUM
DISPERSION
AUTO SWEEP
MIN
MAX
AUDIO
OUTPUT
VOLUME
AM
RF INPUT
BATTERY
CHARGE
CONTROL
LOCAL
REMOTE
ZERO
LOG
LIN
dBµV
LOW
OPERATE
BATTERY TEST

Figure 3.1

CPR-25 Front Panel

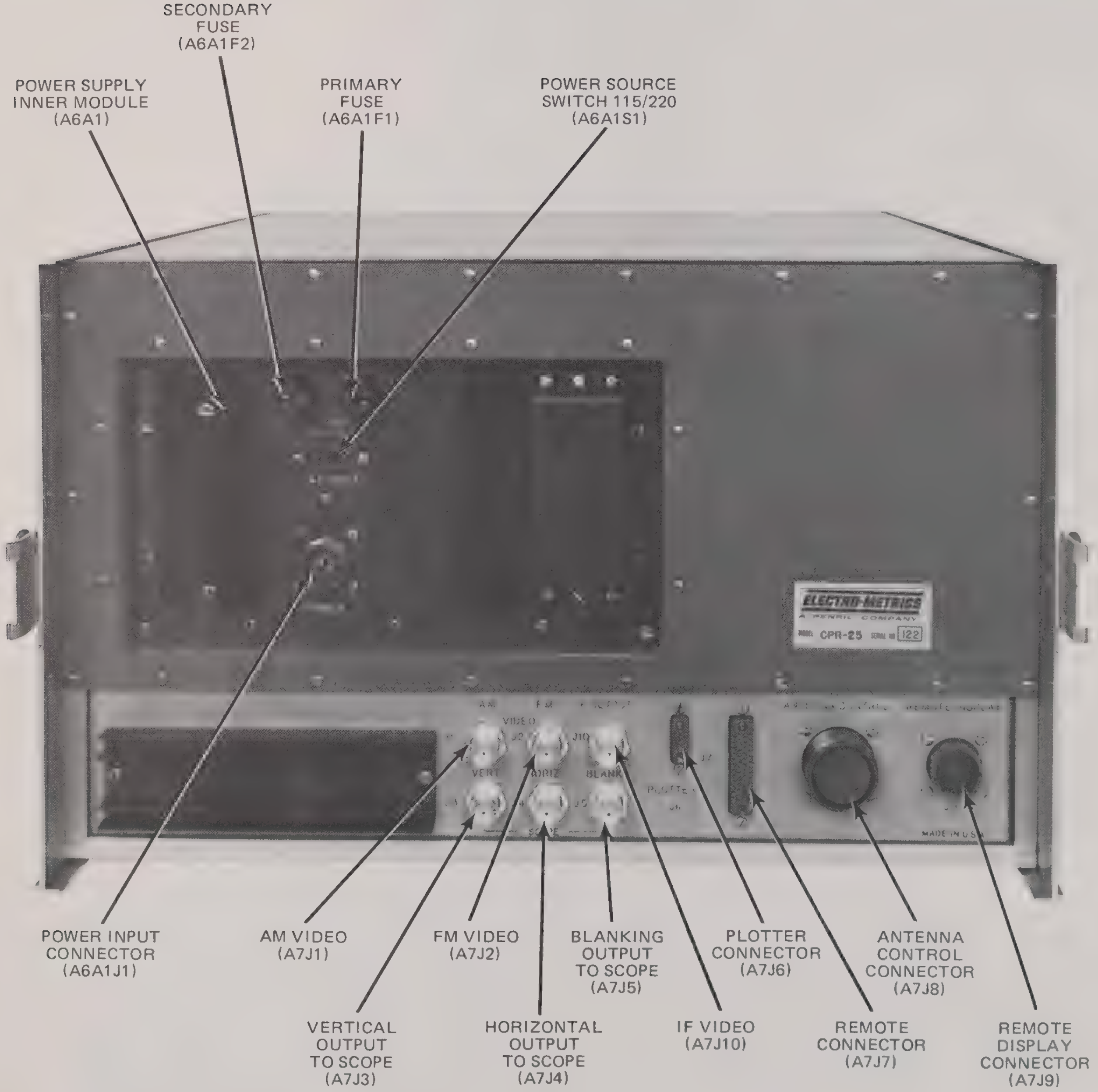

SECONDARY FUSE (A6A1F2)
POWER SUPPLY INNER MODULE (A6A1)
PRIMARY FUSE (A6A1F1)
POWER SOURCE SWITCH 115/220 (A6A1S1)
ELECTRO-METRICS
A PENRIL COMPANY
CPR-25
122
VIDEO
J2
J10
VERT
HORIZ
BLANK
SCOPE
MADE IN U.S.A.
POWER INPUT CONNECTOR (A6A1J1)
AM VIDEO (A7J1)
FM VIDEO (A7J2)
BLANKING OUTPUT TO SCOPE (A7J5)
PLOTTER CONNECTOR (A7J6)
ANTENNA CONTROL CONNECTOR (A7J8)
VERTICAL OUTPUT TO SCOPE (A7J3)
HORIZONTAL OUTPUT TO SCOPE (A7J4)
IF VIDEO (A7J10)
REMOTE CONNECTOR (A7J7)
REMOTE DISPLAY CONNECTOR (A7J9)

Figure 3.2

CPR-25 Rear Panel

3.3.2.7 FREQUENCY RANGE INDICATOR

A LED display which indicates the frequency range band segment the instrument is presently utilizing.

3.3.3 CAL FUNCTION

3.3.3.1 CAL SWITCH

Pushbutton switch which activates the internal impulse generator and disconnects the instrument's RF input.

3.3.3.2 CAL GAIN CONTROL

Precision control which adjusts the instrument gain to permit amplitude calibration.

3.3.4 AUDIO

3.3.4.1 AUDIO VOLUME CONTROL

Used to adjust the audio output level to the phone jack.

3.3.4.2 AM/FM AUDIO SWITCH

A two position toggle switch which selects the desired audio output signal.

3.3.5 POWER SWITCH

A lighted pushbutton switch which is used to place the instrument in operation. When the unit is on, the switch is illuminated and extinguished when off.

3.3.6 BATTERY INDICATOR

The lower section of the front panel meter scale indicates the condition of the optional internal battery (BAT-25R) whenever the Battery Test switch is pressed.

3.3.6.1 BATTERY TEST SWITCH

When pressed, disconnects the front panel meter from the internal meter circuitry and places the battery, through a meter protection circuit, across the meter.

3.3.6.2 CHARGE INDICATOR

Front panel LED lamp which will be lit when AC power is applied to the rear of the instrument.

3.3.7 LOCAL/REMOTE SWITCH

A two position rotary switch which allows the instrument to be controlled either internally or externally. In the "Local" position, the analyzer is controlled by the front panel; while in the "Remote" position many of the analyzer's functions are controlled via the rear panel Remote Connector A7J7. The "Remote" position would be used whenever options such as the ESC-125C Programmer or Computer/Calculator control are desireable. These options control the analyzer through the rear panel Remote Connector A7J7.

3.3.8 AFC SWITCH

A two position toggle switch which activates the Automatic Frequency Control circuitry when a selected frequency has been located.

3.3.9 DETECTOR FUNCTION AND OUTPUT SWITCHES

Careful use of the Detector Function and Output switches plus associated controls can yield much information about the type of signal being received.

3.3.9.1 DETECTOR FUNCTION (E) SWITCH

A five position rotary switch which selects one of five detector functions for use in conjunction with the Detector Output switch.

A. Peak: The peak measurement circuit has a rise time 10 usec, with the automatic dump circuit having a hold time of approximately 1.0 second. The peak circuit produces a true peak response of a calibrated RMS equivalent signal.

B. Quasi-Peak: In the Quasi-Peak position, the detection circuitry results in measurements which conform fully to the specifications in FCC Docket 20780 plus CISPR/VDE and ANSI requirements. See table 1-2 for complete bandpass and time constant specifications.

C. RMS: In the RMS position, the RMS detection circuitry produces a true RMS value of the detected video envelope. The charge and discharge time is a nominal 600 msec.

D. Carrier: In the Carrier position, the detection circuitry produces an average value of the detected video envelope. The charge and discharge time is a nominal 600 msec.

E. Slideback: This position produces a metered indication of the threshold bias level for aural extinction of peak levels.

3.3.9.1.1 THRESHOLD

Used in conjunction with the Slideback function, it adjusts the aural extinction point.

3.3.9.2 DETECTOR OUTPUT SWITCH

A four position rotary switch which determines the method by which the RF signal is measured and presented.

A. LIN: In the LIN (LINEAR) position of the switch, the linear presentation circuitry and the 20dB range (-20 to 0dB) linear scale of the front panel meter is utilized.

B. LOG: In the LOG position of the switch, the switch, the LOG presentation circuitry and the 80dB range (-40 to +40dB) log scale of the front panel meter is utilized.

C. RMS/E: RMS/E is the quotient of the true RMS level divided by the Carrier (Average), Quasi-Peak, or Peak levels. The resultant ratio (in dB) is read directly utilizing the log scale of the front panel meter. Since the result is a ratio, no correction factors are added to the meter reading. The RMS/E position utilizes the Time Constant switch in the following manner:

   1. Carrier — The setting of the time constant switch varies both the charge and discharge time.
   2. Quasi-Peak — The time constant switch settings have no effect on the charge or discharge time.
   3. Peak — The setting of the time constant switch varies the discharge time only. The charge time is unchanged.

D. ZERO: This position of the switch is used to zero the meter prior to taking RMS/E measurements.

3.3.9.2.1 ZERO ADJUST

This control pot with a nominal 20dB range is used to adjust the meter for 0dB on the log scale of the front panel meter in RMS/E position only.

3.3.9.3 TIME CONSTANT SWITCH

A three position rotary switch that selects one of three time constants utilized in the RMS/E measurements (20 seconds, 5 seconds, 0.6 second).

3.3.10 SWEEP FUNCTION CONTROLS

These controls are utilized whenever an external X-Y recorder or oscilloscope is being used to record or present the data obtained by the CPR-25.

3.3.10.1 SWEEP START

The Sweep Start switch, when depressed, resets the sweep circuitry back to its initial starting point which is the low end of the band segment the CPR-25 is tuned to. When the switch is released, the sweep circuitry starts sweeping across the selected band at a rate selected by the Sweep Time and Sweep Multiplier Switches.

NOTE: Whenever an external oscilloscopy is being utilized as a spectrum analyzer, the sweep is automatically initiated and continuously repeated.

3.3.10.2 SWEEP TIME/SWEEP MULTIPLIER SWITCHES

A. Sweep Time switch: This is a four position rotary switch with time settings of 0.1, 1.0, 10, and 100 seconds. These set the minimum sweep time per band segment. The 0.1 and 1.0 second ranges are intended for use with an external oscilloscope, while the 10 and 100 second ranges are intended for use with an X-Y recorder.

B. Sweep Multiplier: This control is continuously variable from 1 to 10 times the Sweep Time switch settings. This provides a total sweep time range of 0.1 to 1000 seconds scan time per band segment.

3.3.10.3 SPECTRUM/DISPERSION SWITCH

A two position toggle switch which chooses between either the Spectrum or Dispersion mode of data presentation.

A. Spectrum: In this position the entire octave band segment being scanned is presented on either the X-Y recorder's chart or as a spectrum display on the CRT of a conventional oscilloscope.

B. Dispersion: In this position, which is utilized only with an external oscilloscope, the Dispersion control and internal marker function are activated. The Dispersion control allows the spectrum dispersion of the CRT display to be varied from one to one hundred percent of the selected band segment centered at the tuned frequency. With the Dispersion control set at MIN (1%), the entire spectrum display centered around the tuned frequency will be expanded to cover the CRT display area of the oscilloscope. The Marker function is an internal fixed frequency of the CPR-25 Analyzer. As the analyzer is being tuned across the band segment, the marker on the CRT display will also move across the display.

3.3.10.4 AUTO SWEEP SWITCH

A two position toggle switch which controls the operation of the Auto-Sweep circuit.

A. ON: In this position, the Auto-Sweep circuit is activated. This permits the CPR-25 to rapidly scan a band segment until a narrowband signal is encountered; whereupon the sweep speed automatically slows down to allow an accurate X-Y recorder plot of the narrowband signal. After passing through the signal the sweep speed will revert back to the normal sweep speed.

B. OFF: In this position, the sweep speed/Time is controlled by the front panel settings.

3.3.10.5 PEN ≠2

A three position toggle switch which depending on the setting allows the PEN ≠2(Y_2) of a dual pen plotter to plot either RMS, AVERAGE or PEAK.

3.4 FRONT PANEL CONNECTORS

3.4.1 RF INPUT

The nominal 50 ohm input terminal to which the signal to be measured is applied.

3.4.2 AUDIO OUTPUT

Phone jack for the audio output.

3.5 REAR PANEL

3.5.1 REAR PANEL CONNECTORS

3.5.1.1 BNC CONNECTORS

A. AM Video (A7J1): A nominal 50 ohm output that is proportional to the logarithm of the amplitude of the input signal.

B. FM Video (A7J2): A nominal 91 ohm output that is proportional to the instantaneous frequency of the input signal, within the IF bandpass of the band segment being utilized. It will be positive for frequencies above the bandpass center frequency and negative for frequencies below the bandpass center frequency.

C. Oscilloscope Outputs
   1. A7J3 – Vertical Output to oscilloscope.
   2. A7J4 – Horizontal Output to oscilloscope.
   3. A7J5 – Blanking (Z) Output to oscilloscope.

D. IF Video (A7J10): Provides a linear signal output at a frequency of 1.6MHz with the bandwidth determined by the band segment in use. The output will vary depending on the band segment being used but is approximately 1.5mv.

3.5.1.2 PLOTTER CONNECTOR (A7J6)

11 pin connector which connects a single or dual pen X-Y plotter to the CPR-25. Since the CPR-25 has a built-in capability to drive a dual pen plotter, no additional external circuitry or special wiring is needed.

3.5.1.3 REMOTE CONNECTOR (A7J7)

50 pin connector through which the CPR-25 Analyzer is remotely controlled.

3.5.1.4 ANTENNA CONNECTOR (A7J8)

MS round connector which is used to connect the ALR or RVR remote antenna to provide remote switching of the antennas.

3.5.1.5 REMOTE DISPLAY CONNECTOR (A7J9)

PT round connector which is utilized during remote operation by a computer/calculator to supply update information concerning the Frequency Display to the computer/calculator.

3.5.1.6 POWER INPUT CONNECTOR (A6A1-J1)

Connects the CPR-25 via the PCD-25 power cord to the AC line power.

3.6 POWER SUPPLY

3.6.1 POWER REQUIREMENTS

The CPR-25 utilizes the following AC power sources:

A. 105-130 Volts AC

B. 210-260 Volts AC

The above sources can be either 50-60Hz or 350-450Hz.

3.6.2 POWER SOURCE SWITCH

Slide switch located on the power supply compartment cover, which adjusts the power input to the CPR-25 for operation with either a 115VAC or 220VAC power source.

CAUTION

Check to be sure that the Power Source Switch setting corresponds to the AC power source being utilized. Operation on 230VAC with the switch set to 115VAC can cause extensive circuit damage.

3.6.3 FUSE SPECIFICATIONS

The CPR-25 requires 2 fuses with the following specifications:

A. F1: 115VAC operation — 3AMP SLO-BLO
220VAC operation — 1.5AMP SLO-BLO

B. F2: 115VAC or 220 VAC operation — 3AMP SLO-BLO

The fuseholders are located on the power supply compartment cover.

3.6.4 BATTERY OPERATION (OPTIONAL)

CPR-25 operation utilizing an internal battery is the same as for operation from an AC power source. The major difference is that the battery has a limited or finite time of operation. The battery charge status should be checked as soon as the power switch is activated by means of the battery test switch. When pressed, the front panel meter will then indicate the approximate state of the battery charge. In the "operate" state, the instrument is ready to be placed in operation; a low indication means that the battery should be recharged or replaced. Also during periods of extended or heavy usage, it is advisable to check the battery condition periodically.

A fully charged battery will operate the CPR-25 for a nominal time period of six hours. The actual operating time will vary and is dependent on the type of EMI testing the instrument will be performing for the user.

> NOTE: The Frequency Display Module utilizes a majority of the current supplied by the power source to the CPR-25. For periods of extended usage, when a readout of the tuned frequency is not being utilized, the Display Module can be turned off by means of the front panel Display ON/OFF switch. This will decrease current drain, extend battery life, and has no effect on the other CPR-25 functions.

The instrument should not be stored with a discharged battery longer than one week. During long storage periods, the battery should be brought to full charge at least once every three months.

3.6.5 BATTERY POWER SUPPLY

The optional battery pack (BAT-25R) incorporates 24-hour ampere-hour 1.2V nickel-cadmium cells.

The battery can be utilized for a nominal 6 hours of subtained operation without charging. It will fully recharge after such usage in 12 to 16 hours. To recharge the battery, connect the instrument to an external AC source. Battery charging is automatically controlled by the instrument and will occur with the POWER switch OFF only.

The front panel meter indicates the approximate battery condition, when Bat. test button is pressed.

To charge the battery, set the line voltage switch on the rear panel to the appropriate position, and connect the line cord PCD-25. The front charge light will glow, indicating that the charger is operating. The POWER switch must be OFF to obtain charge.

3.6.6 CHARGING THE BATTERY

Battery life is a function of many factors in addition to the charge/discharge ratio. However, maximum life will be obtained from the CPR-25 if the following principles are observed:

A. Operation of the CPR-25 when it is connected to AC power produces no discharge of the battery and avoids the need for recharging to replenish loss.

B. As long as the interval between periods of use does not exceed one week, any loss of charge resulting from battery-only operation a period (T) can be replenished by recharging with the unit off the same length of time (T).

C. When the CPR-25 is being used only infrequently its battery can be kept in optimum and charged condition between use by connecting the CPR-25 to AC, with the front-panel power switch "off," for a total of 6 to 8 hours each week.

3.6.7 BATTERY PROTECTION CIRCUITS

3.6.7.1 OVERCHARGING

Overcharging will not be possible, because the charger circuit automatically reduces charging current as soon as overcharging reaches a significant level.

3.6.7.2 EXCESSIVE DISCHARGE

Excessive Discharge will not be possible, because the flow of battery current to all circuits is automatically interrupted, as soon as battery voltage drops to a value indicating negligible remaining capacity.

3.6.7.3 LINE OPERATION

To operate the instrument from an AC line, adjust the line voltage before connecting the PCD-25 line cord. Then turn the POWER switch on then check the battery condition (if internal battery option is installed) by pressing the BAT Test button and noting if the meter reads in the "operate" region.

3.7 REMOTE OPERATION

3.7.1 PROGRAMMING/EXTERNAL CONTROL

The CPR-25 can be remotely programmed through the Remote Connector (A7J7) by either voltage or resistance control, Figure 3-5 illustrates the 50 pin remote connector with the letter corresponding to the pin and the legend denoting the pin function.

These functions represent the inputs and outputs for the CPR-25. It permits an external programming device to apply external information/instructional programming to the unit through the remote connector input pins and by means of the information on the output pins, determine how the CPR-25 is responding to the external programming. The inputs include frequency range control, tuning control, cal gain control, RF & IF attenuation control, I.G. operation, remote Detector Functions and outputs, and external Dump command. Outputs include BCD coding representing the frequency range band segment being utilized, the X, Y_1, and Y_2 outputs, plus the regulated and raw voltages for utilization by various external accessories.

3.7.2 REMOTE OUTPUT CONNECTORS

A total of three connectors, two of which supply control information to various accessories; the remaining connector is utilized mainly for use in computer/calculator controlled systems. The three connectors are the X-Y Recorder connector (A7J6), Antenna Control connector (A7J8), and the Remote Display connector (A7J9).

The X-Y Recorder connector supplies the X, Y_1, Y_2 outputs to a dual pen X-Y recorder. The Antenna Control connector outputs supply the information needed for controlling the frequency compensating networks of the RVR-25 or ALR-25 Antennas. The Remote Display connector (see Figure 3-6) inputs/outputs allow a computer/calculator controlled system to "read" the frequency being displayed on the Frequency Display LCD readout.

3.8 OPERATING PROCEDURES

This section gives instructions and procedures which should guide the operator in the proper utilization of the CPR-25 Interference Analyzer.

3.8.1 GENERAL POWER UP PROCEDURES

3.8.1.1 Before power is applied to the CPR-25 the following should be checked:

A. That the CPR-25 power source switch is set to correspond to the AC power source being utilized.

B. That Fuse A6F1 is the correct rating for the AC power source being utilized.

3.8.1.2 Connect the unit via its PCD-25 power cord to the selected AC power source and note that the front panel charge light is activated. Turn on the CPR-25 by pushing in the front panel "POWER" switch and note that the switch is illuminated when the unit is on. Allow a minimum warm up period of 20 minutes.

3.8.1.3 Power Up Procedures with Optional Battery (BAT-25R) installed in either of two modes of operation: Battery and AC power source or Battery as sole power source.

3.8.1.3.1 Battery and AC power source: Follow the power up procedures given in Section 3.8.1.1 and 3.8.1.2

3.8.1.3.2 Battery as sole power source:

A. The unit is turned on as per Section 3.8.1.2 using the front panel "POWER" switch. After unit activation, check the status of the battery charge by pressing the "BATTERY TEST" switch.

B. The front panel meter will then indicate the approximate condition of the battery charge as being in one of two conditional states: OPERATE or LOW.
   1. OPERATE: A reading in this portion of the scale indicates that the battery has a sufficient level of charge to allow the user to place the unit into operation after a 20 minute warm up period. During the warm up period, in order to conserve battery power, place the DISPLAY ON/OFF switch into the OFF position.
   2. LOW: A reading in this portion of the scale indicates that the battery has an insufficient level of charge for successful unit operation. The battery in this case should be allowed to charge for a period of 12 to 16 hours with the unit turned off and connected to an AC power source. A battery that does not respond and return to an operating condition, should be replaced.

C. A fully charged battery will operate the CPR-25 for approximately 6 hours. During periods of heavy utilization the battery charge status should be checked periodically. In addition, to reduce current drain during extended periods of operation, the frequency Display readout should be turned off when not needed by means of the DISPLAY ON/OFF switch.

3.8.2 PRE-OPERATIONAL CALIBRATIONS

All measurements made with the CPR-25 are based on its calibration as a two-terminal voltmeter. The built-in calibration standard is an impulse generator whose spectrum is essentially flat between 10 kHz and 1GHz. In addition, broadband correction factors are given in Section 3.8.2.2C for use when broadband measurements are being taken along with a table giving CISPR conversion factors for determining the calibration levels for CISPR Quasi-Peak.

3.8.2.1 CW CALIBRATION

To calibrate the CPR-25 for directly reading signal levels in dB above one microvolt (dB/uV) proceed as follows:

A. Set Controls:

FREQUENCY	– as required
TUNING MODE	– MANUAL
AFC	– OFF
LOCAL/REMOTE	– LOCAL
DETECTOR OUTPUT	– LOG
DETECTOR FUNCTION	– CARRIER

B. Depress the cal button and simultaneously adjust the meter for zero on the LOG scale by utilizing the CAL GAIN control.

C. The instrument is now calibrated. The meter thus indicates the level of the detected input signal in terms of dB above one microvolt dB/uV. Algebraically add the value of the attenuation displayed (in dB) on the Attenuator LCD readout to the meter level for a true indication of input signal level.

D. Set the Detector Function and Output switches plus add attenuation as required for accurate measurements of detected signals.

3.8.2.2 BROADBAND MEASUREMENT

Broadband signal level measurements are denoted in terms of dB above one microvolt per mega hertz (dBuV/MHz), thus to calibrate the CPR-25 for reading broadband signal levels proceed as follows:

A. Calibrate as per Section 3.8.2.1

B. Set Detector Function to PEAK

C. The gain of the instrument is now properly set. To read signal levels in terms of dBuV/MHz, algebraically add the broadband correction factor given below to the meter and attenuator readings. The factor for each IF bandwidth is as follows:

1. 220Hz Bandwidth (Band Segments 1-3): Add 73dB to meter reading.
2. 9kHz Bandwidth (Band Segments 4-10): Add 41dB to meter reading.
3. 120kHz Bandwidth (Band Segments 11-15): Add 18dB to meter reading.

3.8.2.3 BROADBAND/NARROWBAND DESIGNATION

A narrowband signal is defined as one in which the carrier and all side bands fall within the IF bandpass of the receiver. Thus a measurement utilizing Peak, Quasi-Peak, Carrier, or RMS detection will be accurate, since all of the signal's energy will be contained within the bandpass of the CPR-25 Receiver. The measurement reading is made in terms of dBuV or dBuV/meter (radiated). When the frequency components of a signal fall outside the bandpass of the receiver it is defined as broadband. Because some of the signal's energy is not contained within the receiver's bandpass, the measurement reading will be on the low side.

When a signal is determined to be broadband, it becomes more difficult to determine the actual signal amplitude level and certain assumptions must be made. Thus in broadband measurements, it is conventional to assume that the energy density measured within the IF bandwidth of the receiver is distributed evenly across a spectrum at least 1.0MHz wide. The broadband measurements are made in terms of dBuV/MHz and thus the broadband correction factors of the CPR-25 Receiver is added to the front panel meter reading.

The RMS/E Output of the CPR-25 can be utilized to determine if a receiver signal is narrowband or broadband. If the RMS/PEAK ratio is not greater than 3dB, the signal is unquestionably narrowband since a 100% sine wave modulated carrier signal will produce a RMS/PEAK ratio reading of 3dB. If the RMS/PEAK ratio reading does not exceed 5dB it can also be considered a narrowband signal, since a non-symmetrical sinusoidal CW signal within the receiver bandpass usually results in a RMS/PEAK ratio reading of 5dB. If the signal does have some frequency components outside the receiver's bandpass, the error will not be large. If, however, the RMS/PEAK ratio reading exceeds 5dB, the 6dB bandwidth of the received signal should be measured. If this bandwidth is greater than 2 times the IF bandwidth, the received signal should be considered broadband. The CPR-25 broadband conversion factor is then added to the front panel meter reading and the measurement is in terms of dBuV/MHz.

However, the assumption that the energy distribution is uniform over a 1.0MHz spectrum is often not true and can result in measurements that are on the high side. If the bandwidth of the received signal is fairly well defined, the following procedure may be used:

Measure the 6dB bandwidth of the signal. Divide this by the receiver bandwidth, multiply by 6dB and add this to the measured signal amplitude. The resulting amplitude level reading will be at least equal to a receiver having an IF bandwidth equivalent to or greater than the signal bandwidth. The measurement will be in terms of dBuV (narrowband).

3.8.2.4 CISPR (QUASI-PEAK) CALIBRATION CONVERSION FACTORS

The CISPR Conversion Factors (See Table 3-1) are utilized when correlating the output of an external I.G. to a CPR-25 meter reading in the Quasi-Peak position of the Detector Function switch. The CISPR Conversion Factor is used when an external Impulse Generator is being utilized to check the calibration accuracy of the CPR-25. The factor is based upon the IF bandwidth of the CPR-25 versus the pulse repetition rate of the external Impulse Generator. The selected factor is then subtracted from the input level of the I.G. (in dBuV/MHz) to obtain the corresponding level for a CISPR (Quasi-Peak) reading (in dBuV) on the CPR-25 meter. A difference greater than ±2dB between the actual CPR-25 reading and the predetermined reading could indicate faults within the CISPR circuitry.

3.8.3 CPR-25/X-Y RECORDER OPERATION

3.8.3.1 GENERAL

A single or dual pen X-Y recorder can be utilized with the CPR-25 to make semi-automatic measurements. The 11 pin Plotter Connection (A7J6) (see Figure 3-7) connects the CPR-25 via a control cable to the X-Y recorder. Since the CPR-25 has the built-in capability to drive a dual pen plotter, no additional external circuitry or special wiring is needed.

3.8.3.2 CPR-25/X-Y RECORDER CALIBRATION PROCEDURE

NOTE: For the following procedure it is assumed that the CPR-25 is connected to a dual pen X-Y recorder. That the X-Y recorder controls have been adjusted for normal operational use as per the X-Y recorder's instruction manual.

The calibration of the CPR-25 with an X-Y recorder is performed as follows:

A. Set the CPR-25 front panel controls as follows:

MANUAL/SWEEP switch	— MANUAL mode to start
DETECTOR FUNCTION	— CARRIER to start
DETECTOR OUTPUT	— LOG
LOCAL/REMOTE switch	— LOCAL
CAL GAIN control	— as required
ATTENUATION	— 0dB
FREQUENCY RANGE	— BAND SEGMENT 6
TUNING CONTROL (COARSE)	— as required
TUNING CONTROL (FINE)	— Mechanical center

B. Tune the CPR-25 to the low frequency end of the band segment selected.

C. Adjust the plotter X-zero adjustment to position the plotter pens over the left hand margin of the chart paper.

D. Tune the CPR-25 to the high frequency end of the band segment selected.

E. Adjust the plotter X-Gain adjustment to position the plotter pens over the right hand margin of the chart paper.

F. Repeat steps B through E until no further adjustments are necessary.

G. Calibrated the CPR-25 as per Section 3.8.2.1. Tune the CPR-25 to the mid-range frequency of the band segment selected.

H. Adjust the plotter Y_1-zero and Y_2-zero adjustments to position the plotter pens so that the noise level is slightly above the bottom margin of the chart paper.

I. Change the Detector Function switch to the SLIDEBACK position and adjust the threshold bias level for a full scale reading on the front panel meter.

J. Adjust the plotter Y_1-Gain and Y_2-Gain adjustments to position the plotter pens over the top margin of the chart paper.

K. Repeat steps H through J until no further adjustments are necessary.

3.8.3.3 CPR-25/X-Y RECORDER OPERATION

When the above calibration procedure has been completed, the CPR-25 is ready to plot the spectrum of the band segment selected. To initiate the sweep mode of the CPR-25, perform the following:

A. Select sweep time desired from 10 to 1000 seconds.

NOTE: The 0.1 and 1.0 second positions are intended for use with an external oscilloscope. If an external oscilloscope and Y-Y recorder are connected simultaneously to the CPR-25, the recorder should be either removed or turned off while the oscilloscope is being utilized.

B. The SPECTRUM/DISPERSION switch should be placed in the SPECTRUM position since the DISPERSION position is normally utilized for use with an external oscilloscope.

C. Place the MANUAL/SWEEP switch in the SWEEP position and push the SWEEP START button. When the SWEEP START button is released, the sweep circuit will automatically position the plotter pens over the left hand margin of the chart paper, drop the pens and initiate the sweep voltage.

D. When the sweep voltage reaches the end of the band segment, the pens will automatically lift and the sweep will stop.

The noise level and various external IG levels may be plotted on the chart paper to provide calibration lines. The AUTO SWEEP circuit is normally used when a fast sweep speed is being utilized and automatically slows the sweep speed down when a signal is encountered, which permits accurate amplitude level plots to be made. For greater flexibility and completely automatic X-Y recorder operation, the CPR-25 can be utilized with the Electro-Metrics Model ESC-125C Electro-Scan Programmer.

The PEN =2 switch selects whether the PEN =2 plots the RMS, AVERAGE, or PEAK output of the CPR-25. If the Detector Function switch is set to PEAK and the PEN =2 switch is set to PEAK, a CW input should produce equal pen amplitude responses.

3.8.4 CPR-25/OSCILLOSCOPE OPERATION

3.8.4.1 GENERAL

The CPR-25 has the capability and provision for using an external oscilloscope as a spectrum analyzer over any of the octave band segments of the CPR-25.

3.8.4.2 OPERATION

The three CPR-25 oscilloscope outputs are connected to the selected oscilloscope as follows:

A. A7J3 – Vertical output to oscilloscope vertical amplifier.

B. A7J4 – Horizontal output to oscilloscope horizontal amplifier.

C. A7J5 – Blanking (Z) output to oscilloscope blanking input.

The oscilloscope is set for operation with an external horizontal input (X AMP) (see the procedure given in the oscilloscope instruction manual) with both the vertical and horizontal inputs DC coupled. The 0.1 and 1.0 second positions of the SWEEP TIME switch are intended specifically for use with an external oscilloscope and when utilized, the X-Y recorder should be either removed or turned off. For the majority of applications which utilizes the external oscilloscope, the SWEEP TIME switch is set to the 0.1 second position.

After the CPR-25 is connected to the oscilloscope, the Detector Function switch is set to the SLIDEBACK position, with the THRESHOLD bias level control full CCW to start. The SPECTRUM/DISPERSION control is placed in the SPECTRUM position to start. When the MANUAL/SWEEP switch is placed into the SWEEP position, a display will appear on the CRT of the oscilloscope equivalent to the entire CPR-25 band segment being scanned. Whenever an external oscilloscope is being utilized as a spectrum analyzer, the sweep is automatically initiated and continuously repeated.

The frequency of signals appearing on the CRT display is determined by utilizing the MARKER signal produced by the CPR-25. Since the MARKER signal corresponds to the frequency the CPR-25 is tuned to, by positioning the MARKER over the signal in question the frequency of the signal can be read directly from the LCD Frequency Display of the CPR-25.

Switch the SPECTRUM/DISPERSION switch to the DISPERSION position. In this switch position, which is utilized only with an external oscilloscope, the DISPERSION control function is activated. The Dispersion control allows the spectrum dispersion of the CRT display to be varied from one to one hundred percent of the selected band segment centered at the tuned frequency. With the Dispersion control set at MIN (1%), the entire spectrum display centered around the tuned frequency will be expanded to cover the CRT display area of the oscilloscope.

The amplitude of signals appearing on the CRT display can be determined by utilizing the CPR-25 SLIDEBACK THRESHOLD control in conjunction with the CPR-25 ATTENUATOR and front panel meter. A reference point is first established on the CRT display by adjusting the oscilloscope vertical control (X) to position the scope trace to the point desired. This point is established with the CPR-25 THRESHOLD bias level control set full CCW and the CPR-25 front panel meter reading -40dB or the noise level of the bandwidth being utilized.

NOTE: To facilitate making this adjustment, remove the RF input from the CPR-25.

Next increase the CPR-25 SLIDEBACK THRESHOLD control in a CW direction (the trace line will move up the CRT display) until the trace line intersects the peak of the signal that is being measured. The CPR-25 meter reading also increases as the THRESHOLD control is increased CW and by taking this reading, adding it to the CPR-25 ATTENUATOR setting produces the amplitude level of the signal in question.

3.9 ACCESSORIES

3.9.1 GENERAL

A wide range of programming, pickup, and convenience accessories are available for the CPR-25. Programming accessories are those which utilize the inherent capability of the CPR-25 for remote control to provide an automated capability. Pick-up devices extend the CPR-25 capability from a two-terminal tunable voltmeter to a field and current measuring device. Convenience accessories extend the utility of the instrument by providing audible outputs, convenient junction points and remote meter indication, etc.

3.9.2 PROGRAMMING ACCESSORIES

The ESC-125C Programmer utilizes the sweep, bandswitching, X, Y_1, and Y_2 output capability of the CPR-25 to provide completely automatic amplitude vs. frequency X-Y plotting of the frequency spectrum range of 10kHz and 1GHz. In addition the CPR-25 can be utilized in various computer/calculator controlled systems.

3.9.3 RIM-25R REMOTE METER

This accessory item allows amplitude readings to be made at a location up to 25 feet from the CPR-25 Receiver. It consists of an output meter in a small metal enclosure and a permanently attached 25 foot cable. In operation, the connector at the end of the cable is connected to the plotter connector at the rear of the CPR-25. This connects the remote meter in parallel with the front panel meter of the CPR-25. Due to a small loading effect, the CPR-25 should be aplitude calibrated following connection of the remote meter.

3.10 ANTENNAS AND PICKUP DEVICES

3.10.1 GENERAL

For the measurement of an electro-magnetic field, various antennas are used with the CPR-25 Interference Analyzer. Each of the calibrated pick-up devices requires a correction factor to be added to the indicated CPR-25 input level to determine the true field strength. Since the antenna factor normally varies with frequency, this correction factor is termed an "antenna factor" in the case of antennas and is presented in the form of a graph. Typical graphs for the various antennas/pickup devices are shown as Fig. 3.6 through 3.10. Actual correction factors accompany the respective pick-up devices.

3.10.2 RVR-25 ANTENNA

This rod antenna measures the electric field component of an electromagnetic signal over the frequency range of 10kHz to 30MHz. To operate first connect the counterpoise (ground plane) GPA-25 to the top of the antenna base by means of four captive thumb-screws. Next, screw the telescopic rod into the socket in the center of the circular insulator of the base and extend it fully (41"). The antennas may be bench-mounted or mounted on the TRP-25 tripod. For screen room applications, where practical, the ground plane should be bonded to the screen room wall. Control cable, ACC-25, is connected between the multi-pen connector on the antenna base, and the rear-panel antenna control connector of the CPR-25, to band switch the antenna automatically according to the CPR-25 band setting. Next, connect RF cable, CAC-25, from the RF input connector on the antenna base to the RF input on the front-panel of the CPR-25. The signal injection connector on the antenna base is not used. Since most signals in the frequency range of this antenna are vertically polarized, and since the antenna is omni-directional in the horizontal plane, it does not normally need to be oriented for best reception. Once the desired signal is tuned in on the CPR-25, and the input level to the CPR-25 determined, the antenna factor for the frequency used is determined by referring to the antenna factor graph for the actual RVR-25 being used. This factor is added to the measured input level. This results in the electric field measurement in terms of dBuV/m. (dB above one microvolt per meter).

3.10.3 ALR-25 ANTENNA

This loop antenna measures the magnetic field component of the electromagnetic field over the frequency range of 10kHz to 30MHz. However, its antenna factor converts into terms of the equivalent electric field. It is connected to the CPR-25 by means of a control cable (ACC-25) connected from the multi-pen connector on the antenna base to the rear panel CPR-25 antenna control connector and an RF cable CAC-25 connected from the RF output of the antenna base to the front panel RF input to the CPR-25. The ALR-25 may be either bench mounted or mounted on the TRP-25 Tripod. It is bi-directional in the plane of the loop, and must be oriented for best sensitivity. In use, the signal of interest is tuned in and the antenna is rotated for highest level. The input level to the

CPR-25 is determined and the antenna factor obtained from the graph furnished with the ALR-25 being used. The resulting answer is the equivalent electric field expressed in dBuV/m (dB above one microvolt per meter). To determine the actual magnetic field, expressed in terms of dBuat (dB above one microamper return) an additional correction factor of 51.5dB is subtracted.

3.10.4 BIA-25 BICONICAL DIPOLE ANTENNA (20MHz–200MHz)

This broadband dipole antenna is normally stored disassembled. It consists of two "Egg-beater"-shapped" boom. An adjustable clamp on the boom is used for tripod mounting (TRP-25), using the AMT-25 antenna mount adapter and one or two of the MSA-25 mast sections. The antenna is connected to the CPR-25 RF input by means of the CAC-25 cable. The antenna is both bi-directional and polarized, so that it must be rotated and turned on its axis for maximum signal indication. The antenna factor for the frequency of measurements, taken from the chart furnished with the BIA-25, is added to the measured CPR-25 input to determine the incident field strength expressed in terms of dBuV/m. (dB above one microvolt per meter).

3.10.5 LCA-25 LOG CONICAL SPIRAL ANTENNA (200–1000MHz)

This antenna is connected to the CPR-25 by means of the CAC-25 RF cable. It is mounted to the TRP-25 tripod using the AMT-25 antenna mount adapter and one or two MSA-25 mast sections. It is uni-directional and most sensitive when the apex of the cone is pointed toward the radiating source. It is circularly polarized so that it is not necessary to rotate the antenna on its axis, regardless of the direction of polarization of the received signal. Typical near field (1 meter spacing) antenna factors are given in Fig. 3.9. When the appropriate antenna factor, from data furnished with the respective LCA-25, is added to the CPR-25 input level the result is the field strength in terms of dBuV/m.

3.10.6 PCL-26 CURRENT PROBE (10kHz to 110MHz)

This hinged magnetic pickup device is made to enclose a single conductor, to measure the RF current traveling on it. In use, the donut-shaped probe is opened by loosening the thumb screw and swinging it open on its hinge. A single conductor is positioned in the center hole and the probe is closed and secured by the thumb screw. The probe is connected to the EMC-25 front panel RF input connector using the CAS-25 RF cable. The CPR-25 is tuned to the frequency of interest and an amplitude measurement made. The probe correction factor, obtained from the curve furnished with the probe, is added to this CPR-25 input level. The result is in terms of dBua (dB above one microampere). If more than one conductor is positioned through the probe an error will result as the probe will measure the vector sum of the currents.

3.10.7 MFA-25 AND MFB–25 and MFC-25 MAGNETIC FIELD PROBES

These small hand-held loops, color-coded by frequency range, are uncalibrated and are intended for use in locating the source of localized magnetic radiation. The red probe (MFA-25) is for use over the 10kHz to 520kHz frequency range. The white probe (MFB-25) is used from 0.48MHz to 25MHz. The blue probe (MFC-25) is used from 22MHz to 230MHz. These magnetic probes are not used above 230MHz.

3.10.8 EFP-25 ELECTRO-STATIC FIELD PROBE (10kHz–1000MHz)

This is a hand-held uncablirated probe used to investigate the source of localized electric field radiation. It is useful over the entire 10kHz to 1000MHz frequency range of the CPR-25 Interference Analyzer.

TABLE 3.2

CISPR CONVERSION FACTORS

Impulse Generator Repetition Rate (Hz)	Bands 1-3 (220Hz BW) .01–0.15MHz	Bands 4-10 (9kHz BW) 0.15–25MHz	Bands 11-15 (120kHz BW) 25–1000MHz
1	97	71	58.5
2	93	68	56
5	87	61	50
10	84	57	44
15	81	55	41
20	80	53.5	39
30	78	51.5	35.5
40	77.5	50	34
50	77	49	33
60	76.8	48.5	32.4
70	76.5	48	32
80	76.3	47.8	31
90	76.1	47.3	30.5
100	76	47	30

Subtract from I.G. input level (in dBuV/MHz) to determine CISPR level (in dBuV).

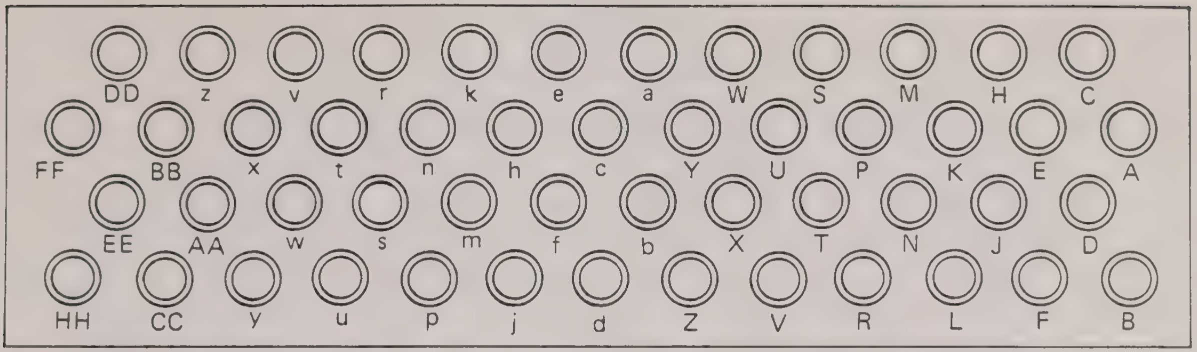

DD z v r k e a W S M H C
FF BB x t n h c Y U P K E A
EE AA w s m f b X T N J D
HH CC y u p j d Z V R L F B

FIGURE 3.3 REMOTE CONNECTOR A7J7 (FRONT VIEW)

A	Tuning Pot Arm (Manual)
B	Spare
C	Tuning Voltage Input (0 to + 1.5V nom.)
D	Spare
E	Spare
F	Antenna Inhibit
H	Remote RMS/E = Low
J	Tune GND
K	Analog GN
L	Remote Linear = Low
M	X-Y Plot Pen Lift+
N	Spare
P	Gain Control IN
R	Spare
S	Spare
T	Dump Command
U	Spare
V	+12 Volts
W	Spare
X	-6 Volts DC (Regulated)
Y	Band Step ↓
Z	Digital GND
a	CAL Command (Remote)
b+	Y1 Out
c+	X Out
d	+Y2 Out
e	Band Step ↑
f	Remote Peak = Low
h	Band Logic Common
j	Spare
k	0-1 Band Logic
m	Remote RMS = Low
n	0-2 Band Logic
p	Remote Carrier = Low
r	0-4 Band Logic
s	Remote IF Atten 10dB
t	0-8 Band Logic
u	Remote RF Atten 10dB
v	Remote RF Atten 20dB
w	Remote RF Atten 40dB
x	Spare
y	Remote IF Atten 20dB
z	Spare
AA	Gnd
BB	Spare
CC	-7 to -15VDC Raw
DD	Spare
EE	Spare
FF	Spare
HH	+15 to +24VDC Raw

ANTENNA CONTROL CONNECTOR A7J8

A	GND
B	1-Logic
C	2-Logic
D	4-Logic
E	8-Logic
G	Cal Command
H	-12VDC
I	+20VDC

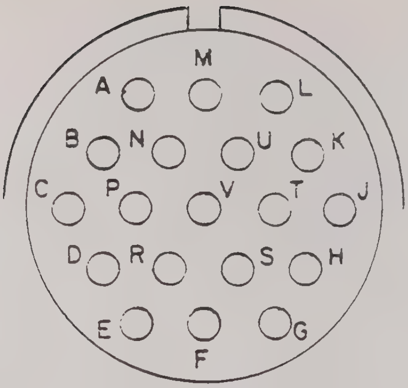


FIGURE 3.4

REMOTE DISPLAY CONNECTOR A7J9

A	Digit Address 1	L	Digit Address 2
B	Spare	M	WE (Read Enable)
C	Digit Address 4	N	Spare
D	BCD 1 Out	P	Spare
E	BCD 2 Out	R	Spare
F	BCD 4 Out	S	Spare
G	BCD 8 Out	T	Spare
H	Write Enable	U	Spare
J	GND	V	Spare
K	Remote Display On/Off		

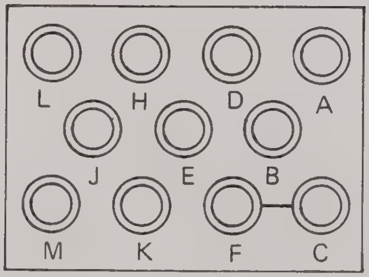
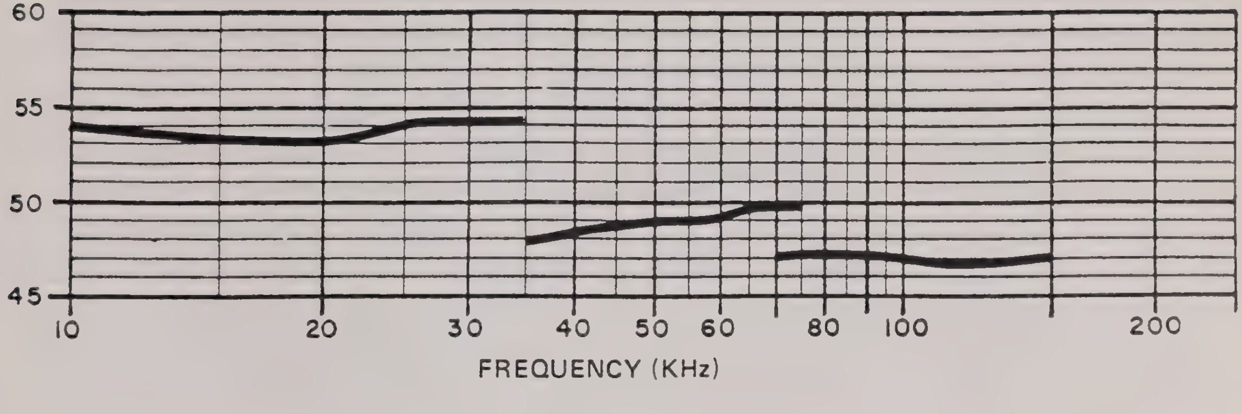


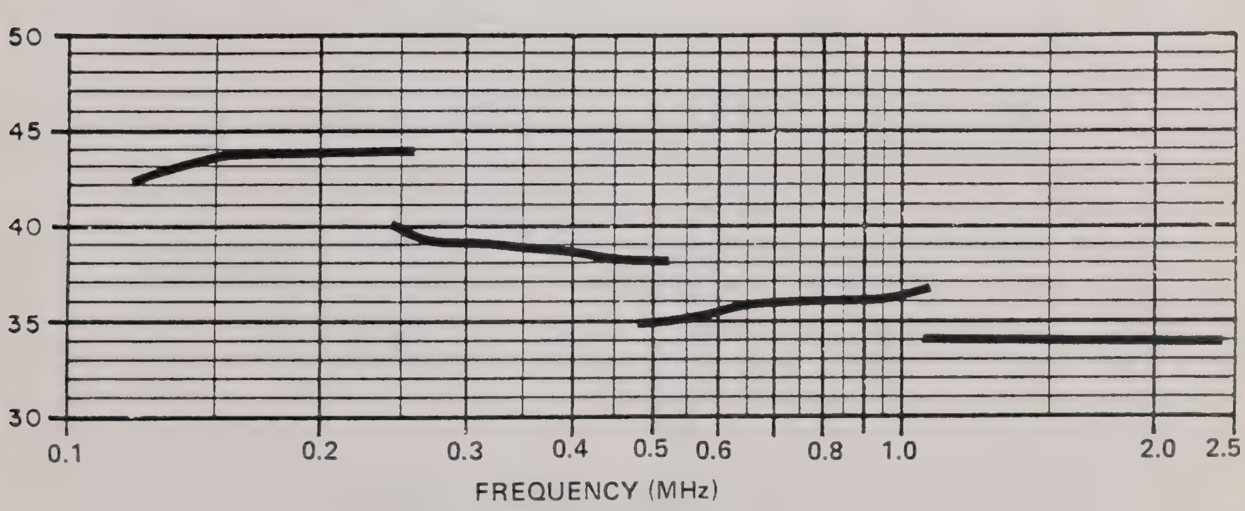
FIGURE 3.5

PLOTTER CONNECTOR A7J6

A	PEN LIFT RETURN	H	+Y2
B	+X	J	-Y2
C	GND	K	SPARE
D	PEN LIFT	L	SPARE
E	-X	M	+Y1
F	-Y1		

ANTENNA FACTOR CHART
RVR-25
(TYPICAL)





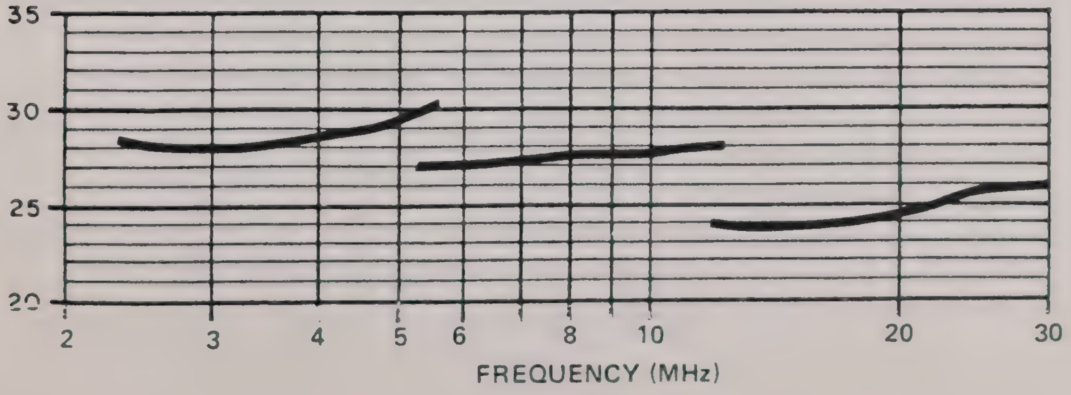


FIGURE 3.6

ANTENNA FACTOR CHART
ALR-25
(TYPICAL)

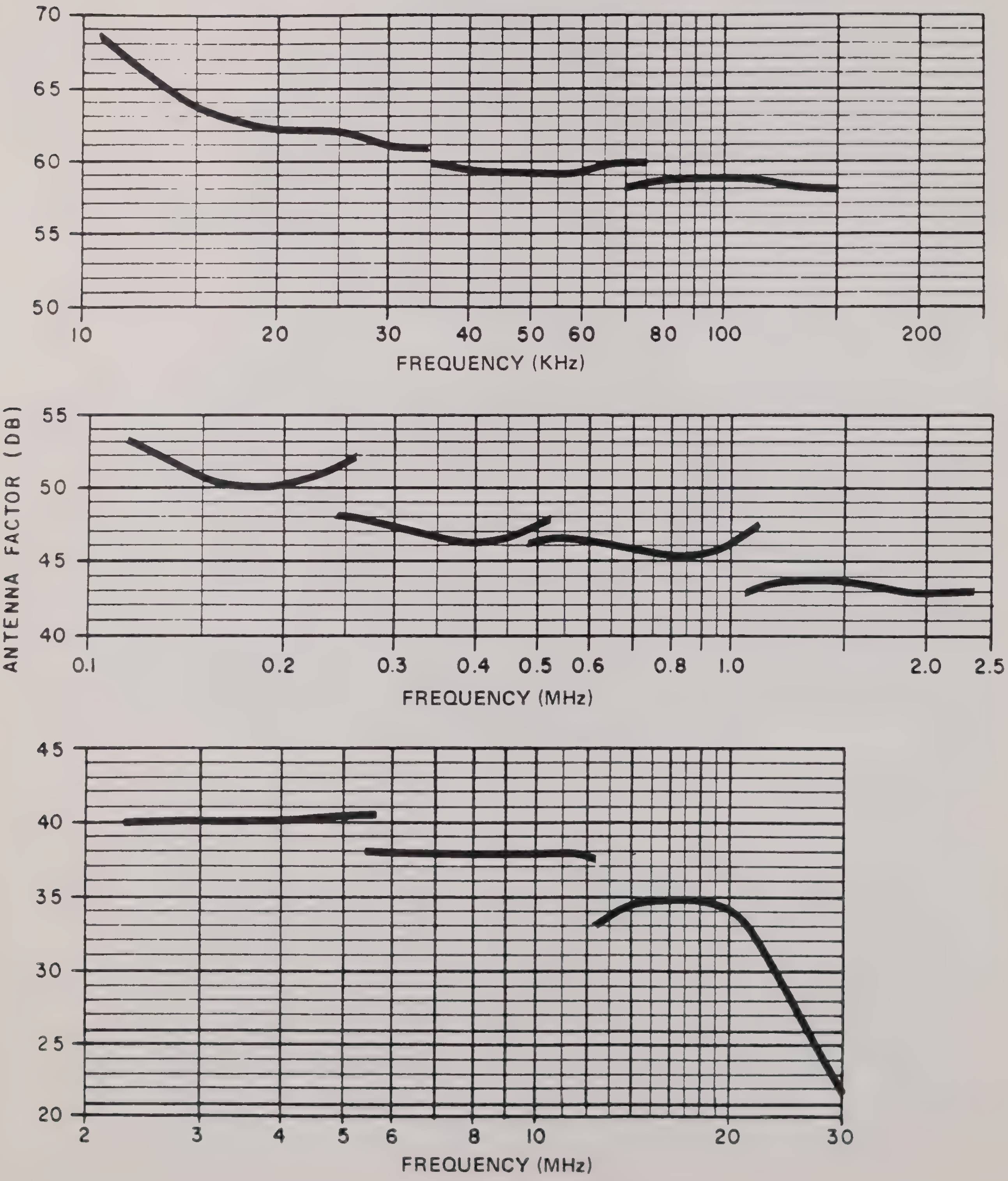
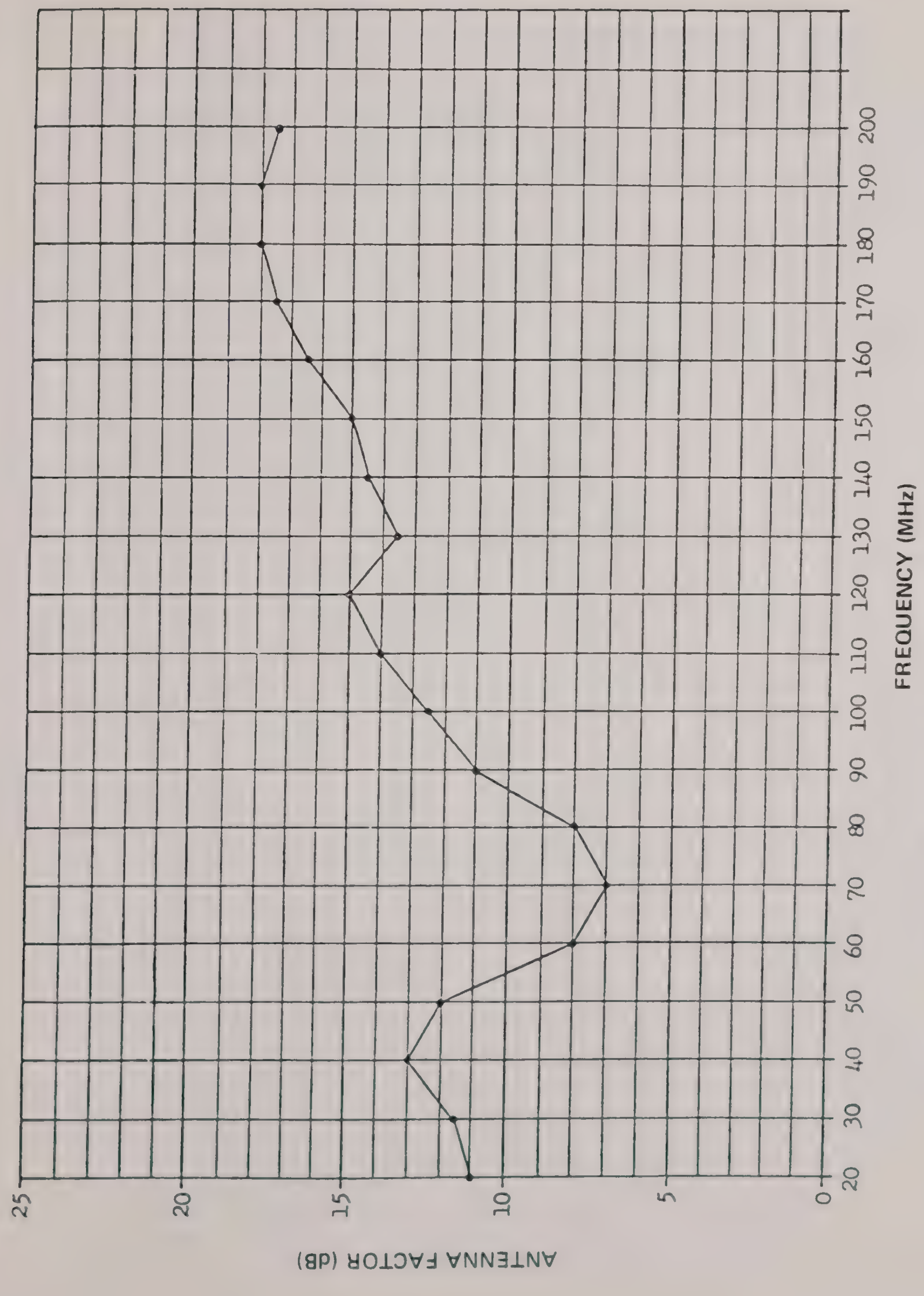
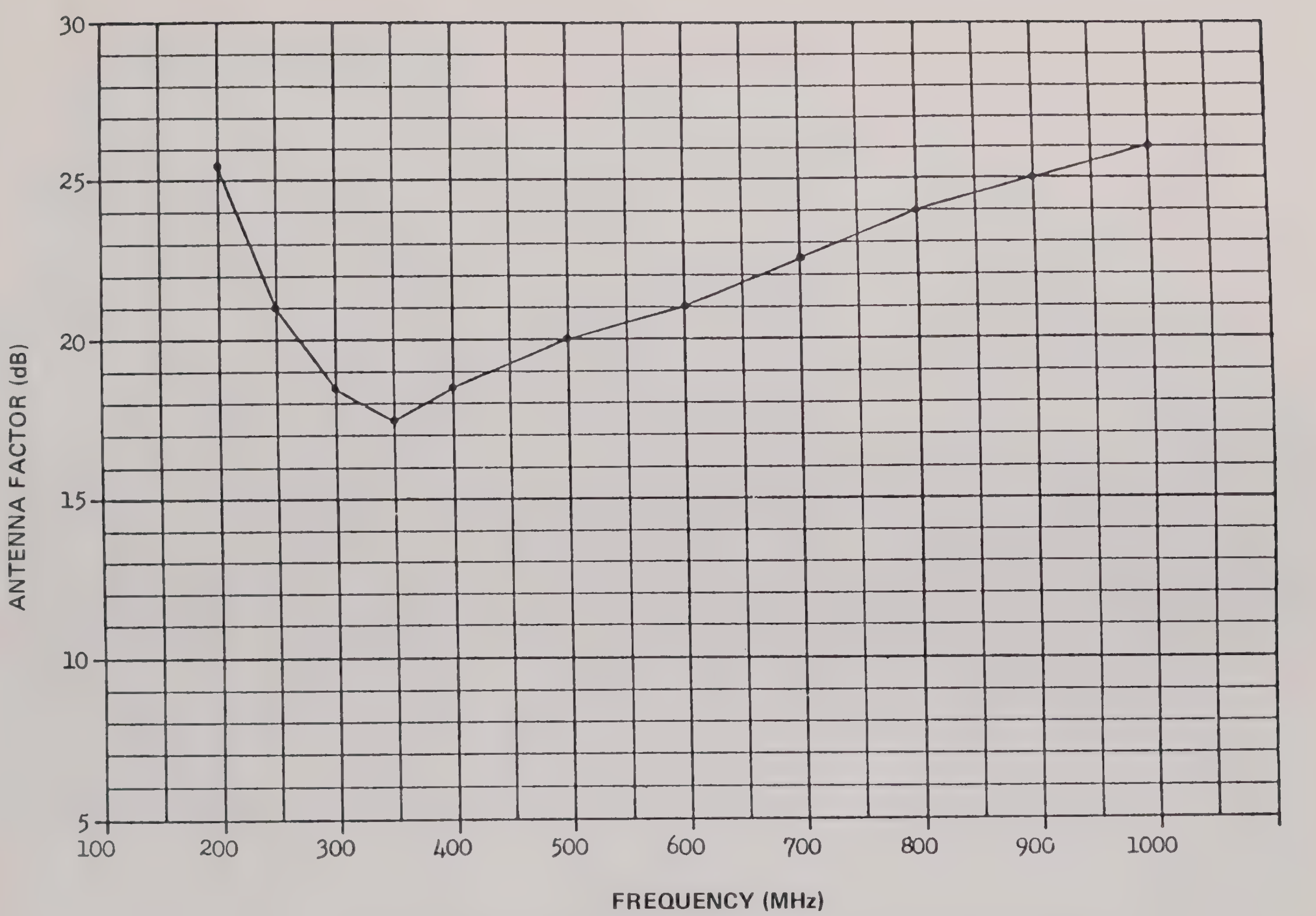


FIGURE 3.7



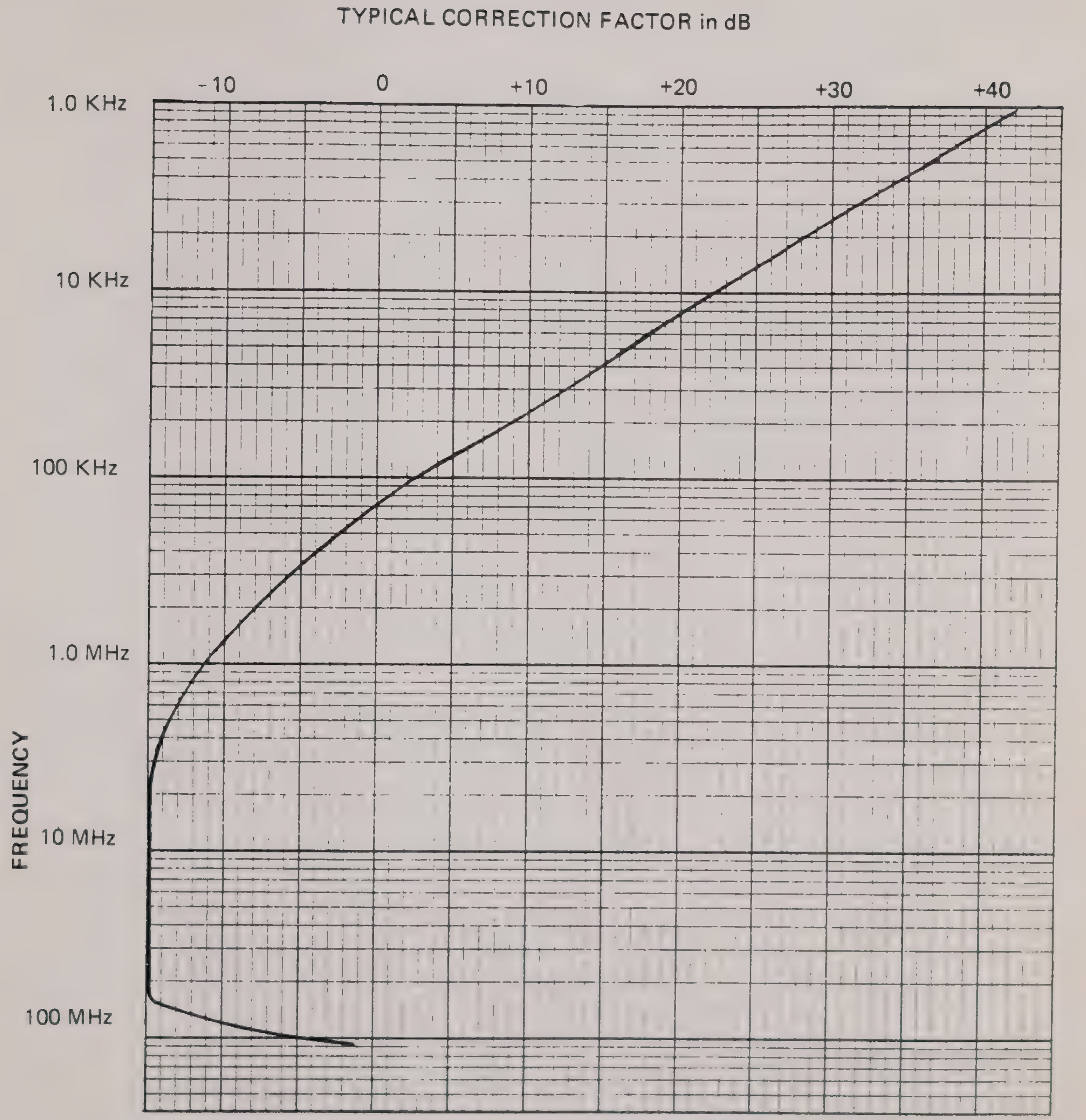
Typical Antenna Factor vs. Frequency for the Model BIA-25 Biconical Antenna

FIGURE 3.8



Typical Specification Compliance Testing Antenna Factor, 1 Meter Spacing, Circular Polarization Model LCA-25 Log-Conical Antenna

FIGURE 3.9



INSTRUCTIONS

Add Factor (dB) shown above to convert 2 terminal EMC-25 reading to conducted current.
PCL-25 Current Probe.

FIGURE 3.10

SECTION IV

Performance Check

4.1 GENERAL

The performance tests listed in this section are designed to give specific information on the operational status of the instrument. The results of these tests will indicate whether the CPR-25 is performing within specification limits and if repair or recalibration is required. The following test procedures should be performed as part of the incoming inspection check and the results recorded for future reference as a standard for maintenance level testing and troubleshooting.

Table 4-1 lists the recommended test equipment and its performance ratings and characteristics. (Note: Any equivalent test equipment with similar ratings and characteristics can also be substituted.)

TABLE 4-1 RECOMMENDED TEST EQUIPMENT

Equipment	Performance Ratings	Recommendations
SIGNAL GENERATOR	10kHz – 100MHz Frequency Accuracy ±0.1% Amplitude Accuracy ±1.0% Output Level −20 dBuV to +120dBuV Source Impedance 50 ohms	HEWLETT PACKARD HP 8640B with 11710B Down Converter
10dB STEP ATTENUATOR	Frequency Range DC to 1GHz Attenuation Range 0 to 12 0dB HP Accuracy +0.5dB	HEWLETT PACKARD 355D
Impulse GENERATOR	Variable Repetition Rate 1 – 100Hz CALIBRATED OUTPUT LEVEL 0 TO 120dBuV/MHz	ELECTRO-METRICS CIG-25
FREQUENCY COUNTER	CALIBRATED FREQUENCY RANGE 10kHz to 1GHz ACCURACY 0.1%	

4.2 WHEN TO UTILIZE TEST PROCEDURES

The performance test procedures should be utilized as follows:

A. As part of the incoming inspection check, with the results recorded for future reference.

B. As part of the periodic maintenance and calibrations test checks after every 2000 hours of operation.

C. As part of the repair procedure to locate and isolate malfunctioning circuits.

4.3 PRELIMINARY PRECAUTIONS

A. Always verify that the AC Power Source switch setting corresponds to the AC power source being utilized.

B. Allow a minimum warm up period of 20 minutes before proceeding with the Performance Test Procedures.

C. Caution should be taken to avoid or minimize ground loops between the AC operation test equipment and the CPR-25.

D. Interconnection coaxial cables should be of the shortest possible length or be of known loss.

E. Accuracy of the test equipment must be commensurate with that of the parameter being measured.

F. The CPR-25 must be within 30° of the horizontal position and right side up whenever the internal impulse generator is being utilized.

G. Some external impulse generators are calibrated in terms of equivalent peak CW voltage, while the majority are in terms of equivalent RMS voltage. A difference of 3dB exits between the two types of impulse generators, therefore 3dB must be subtracted from a peak voltage calibrated instrument's indicated output to obtain the equivalent RMS value. The CPR-25 is calibrated in terms of the equivalent RMS value of the peak signal for impulse signals. In addition, the Electro-Metrics Model CIG-25 Impulse Generator is similarly calibrated.

H. The Proper source impedance of 50 ohms must be presented to the CPR-25 RF INPUT. In addition, some Impulse Generators require a padded output in order to operate correctly.

4.4 PERFORMANCE TEST PROCEDURES

4.4.1 INITIAL CONTROL SETTINGS

A. Unless otherwise specified, set the CPR-25 front panel controls as follows:

LOCAL/REMOTE switch	LOCAL
DETECTOR FUNCTION switch	QUASI-PEAK
DETECTOR OUTPUT switch	LINEAR
TUNING CONTROL mode	MANUAL
FREQUENCY DISPLAY switch	ON
AFC switch	OFF
COARSE TUNING CONTROL	MID-RANGE to start.
FINE TUNING Control	MID-RANGE (Mechanical center)

4.4.2 CW VOLTAGE ACCURACY

Specification: Full Scale ±2.0dB

Equipment used: Signal Generator (10kHz to 1000MHz)

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE	BAND 1
ATTENUATION setting	-20dB

NOTE: During the performance of the following procedure, each band segment is checked at three frequency points on the band segment. The selection of the actual test frequencies is not critical but in order to obtain an overall performance evaluation of the selected band segment, frequencies near the lower, middle, and upper frequency limits are usually chosen.

B. Depress and hold in the CAL pushbutton switch, while simultaneously adjusting the front panel CAL GAIN Control for a reading of 0dB on the front panel meter Log scale. After the CAL adjustment is completed, release the CAL switch.

C. Repeat for each of the three test frequencies selected for BAND SEGMENT 1 the following: CAL as per step B and using a signal generator apply a CW signal at a level of -20dBuV (0.1uV) to the RF Input of the CPR-25. Peak the signal generator for maximum on the CPR-25 front panel meter Linear scale. Verify that the meter reads: Full Scale ±2.0dB.

D. Repeat steps B and C for BAND SEGMENTS 2 qnd 3.

E. Repeat steps B and C for BAND SEGMENTS 4-10 using a CW input signal level of 0dBuV (1uV). The ATTENUATION DISPLAY will indicate 0dB for BAND SEGMENTS 4-10.

F. Repeat steps B and C for BAND SEGMENTS 11-15 using a CW input signal level of +30dBuV (30uV). Set the ATTENUATION DISPLAY for +30 dB.

4.4.3 CISPR CALIBRATION ACCURACY

Specification: As per the CISPR CONVERSION FACTORS CHART (Table 3-2) Section 3.

Equipment used: CIS-25 Variable Repetition Rate Impulse Generator.

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE . . . . BAND 3
COARSE TUNING Control . . . .Set for 0.110MHz on the FREQUENCY DISPLAY
ATTENUATION setting . . . . -10dB

B. With the front panel controls set as per 4.4.3.A, connect the output of a variable repetition rate CIG-25 Impulse Generator to the front panel RF INPUT connector A1J1. Initially set the CIG-25 repetition rate of 100Hz.

C. Set the CIG-25 input level to produce a Full Scale (0dB) reading on the front panel meter Linear scale.

D. Algebraically subtract the CIG-25 input level (in dBuV/MHz) from the CPR-25 Full Scale Linear meter reading. (NOTE: The required CW input level is indicated by the ATTENUATOR DISPLAY reading e.g. -10dB indicates that the CW input level for a Full Scale reading is -10dBuV). The result should be the CISPR CONVERSION FACTOR for the Impulse Generator repetition rate and CPR-25 bandwidth being utilized (see example given). Use the CISPR CONVERSION FACTORS CHART (TABLE 3-2) to verify the results obtained.

Example:
CPR-25 front panel control set per 4.43A e.g. BAND 3 – MID RANGE, ATTENUATION DISPLAY INDICATES -10dB, etc.

CIG-25 set for a 100Hz repetition rate.

The CIG-25 output level is set at 66dBuV/MHz to produce a Full Scale Linear meter reading. The equivalent CW signal level for a Full Scale reading is -10dBuV. Thus Algebraically subtracting the Full Scale CW equivalent reading from the CIG-25 output level equals:

CIG-25 OUTPUT LEVEL = +66dBuV/MHz
CPR-25 FULL SCALE LEVEL = (–)–10dBuV/MHz
+76 CISPR FACTOR

Thus the result of 76 is the CISPR CONVERSION FACTOR for a 100Hz repetition rate and a bandwidth of 220Hz.

E. Repeat steps B thru D for the following repetition rates: 80Hz, 60Hz, 40Hz, 20Hz, 15Hz, 10Hz, 5Hz, 2Hz, and 1Hz.

F. Repeat steps B thru C from BAND 6 at 800kHz (ATTENUATION DISPLAY will indicate +10dB) and BAND 11 at 37.5MHz (ATTENUATION DISPLAY will indicate +20dB).

4.4.4 ATTENUATOR ACCURACY

Specification: ±2.0dB

Equipment used: Signal Generator (10kHz to 1000MHz). 10dB Step Attenuator.

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

DETECTOR OUTPUT switch . . . . LOG
FREQUENCY RANGE . . . . BAND 3
COARSE TUNING Control . . . .Set for 0.110MHz on the FREQUENCY DISPLAY
ATTENUATION Setting . . . . .0dB to start.

B. Apply a 110kHz CW signal via a 10dB step attenuator to the CPR-25 RF INPUT connector. Set the external step attenuator for 80dB of attenuation and the signal generator output level at 80dBuV (10mV).

C. Peak the signal for maximum on the CPR-25 front panel meter Log Scale. The meter should read 0dB, if not adjust the front panel CAL GAIN Control to obtain this reading. This sets the reference point for the following procedure.

D. Starting with the external step attenuator set for 80dB of attenuation and the internal CPR-25 attenuation set on 0dB, decrease the external CPR-25 attenuation in 10dB steps. The difference between the 0dB reference point and the actual meter reading should be = ±2.0dB.

E. Repeat steps B thru D for BAND SEGMENT 6 at a frequency of 800 kHz and for BAND SEGMENT 11 at a frequency of 37.5MHz.

4.4.5 CW SENSITIVITY

Specification: As per the SENSITIVITY and BANDWIDTH Specification Chart (Table 1-1) Section 1.

Equipment used: Signal Generator (10kHz to 1000MHz).

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE . . . . BAND 1
ATTENUATION Setting . . . . -20dB

NOTE: During the performance of the following procedure, each band segment will be checked at three frequency points across the band segment. See the NOTE in 4.4.2 concerning selection of the three test frequencies.

B. Calibrate the CPR-25 as per the procedure of 4.4.2B. After the receiver is calibrated for the selected band segment frequency point, record the residual noise level at that point with no input signals applied to the unit.

C. Repeat for each of the three test frequencies selected for BAND SEGMENT 1 the following: CAL and record the residual noise as per step B and using a signal generator apply a CW signal at a level of -20dBuV (0.1uV) to the RF INPUT of the CPR-25. Peak the signal generator for maximum on the CPR-25 front panel meter Linear scale. The meter should read Full Scale ±2.0dB.

D. Decrease the input level of the signal generator until the front panel meter reads 3dB above the residual noise level. Record the signal level (in uV) require to obtaithe 3dB meter reading, which is equivalent to the CW sensitivity for BAND SEGMENT 1 at the test frequency selected. Sensitivity specifications may be obtained from the SENSITIVITY and BANDWIDTH Chart (Table 1-1) Section 1.

E. Repeat steps B thru D for BAND SEGMENTS 2 and 3.

F. Repeat steps B thru D for BAND SEGMENTS 4-10, CW input signal level of 0dBuV (1uV) required for an initial Full Scale meter reading-Linear scale. ATTENUATION DISPLAY should read 0dB.

G. Repeat steps B thru D for BAND SEGMENTS 11-15, CW input signal level of +10dBuV (3uV) required for an initial Full Scale meter reading-Linear scale. ATTENUATION DISPLAY should read +10dB.

4.4.6 DYNAMIC RANGE – METER TRACKING

Specification: ±2.0dB LINEAR and LOG SCALES.

Equipment used: Signal Generator (10kHz to 1000MHz). 10dB Step Attenuator.

4.4.6.1 DYNAMIC RANGE – LINEAR SCALE

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE . . . . BAND 3
COARSE TUNING Control . . . .Set for 0.110MHz
on the FREQUENCY DISPLAY
ATTENUATION Setting . . . . -20dB

B. Using a signal generator, apply via a 10dB step attenuator a 110kHz CW signal at a level of -20dBuV (0.1uV) to the RF INPUT of the CPR-25. Initially set the step attenuator for 0dB of attenuation.

C. Peak the signal generator for maximum on the front panel meter, the meter should read Full Scale (0dB) on the Linear scale. If not, adjust the front panel CAL GAIN Control for a Full Scale reading.

D. Change the external step attenuator in 10dB steps. Verify that the -10dB and -20dB positions of the Linear scale are within the specification limits of ±2.0dB.

E. Repeat steps B thru D for BAND 6 at 800kHz. The input signal level is 0dBuV (1uV), while the ATTENUATION DISPLAY should read 0dB.

F. Repeat steps B thru D for BAND 11 at 37.5MHz. The input signal level is +10dBuV (3uV), while the ATTENUATION DISPLAY should read +10dB.

4.4.6.2 DYNAMIC RANGE – LOG SCALE

A. Set the CPR-25 front panel controls as per 4.4.6.1A except for the following:

DETECTOR OUT switch . . . . LOG
ATTENUATION Setting 0dB

B. Using a signal generator, apply via a 10dB step attenuator a 110kHz CW signal to the RF INPUT of the CPR-25. Set the signal generator output level at +10dBuV (3uV) and the 10dB step attenuator for 30dB of attenuation. This sets the input signal level into the CPR-25 at -20dBuV (0.1uV).

C. Peak the signal generator for maximum on the front panel meter, the meter should read -20dB on the Log Scale. If not, adjust the front panel CAL GAIN control for a -20dB reading.

D. Using the -20dB position of the Log Scale as the reference point, change the external step attenuator in +10dB steps. Verify that the following positions of the Log Scale meet the specification limits of ±2.0dB: -40dB, -30dB, -20dB(Ref), -10dB, 0dB, and +10dB.

E. Repeat steps B thru D for BAND 6 at 800kHz. Set the signal generator output level at +30dBuV (30uV) and the external step attenuator for 30dB of attenuation. This will set the initial input signal level into the CPR-25 at 0dBuV (1uV). Using the 0dB position of the Log Scale as the reference point, verify that the following positions of the Log Scale meet the specification limits of ±2.0dB: -30dB, -20dB, -10dB, 0dB(Ref), +10dB, +20dB, and +30dB.

F. Repeat steps B thru D for BAND 11 at 37.5MHz. Set the signal generator output level at +40dBuV (100uV) and the external step attenuator for 30dB of attenuation. This will set the initial input signal level into the CPR-25 at +10dBuV (3uV). Using the +10dB position of the Log Scale as the reference point, vertify that the following positions of the Log Scale meet the specification limits of +2.0dB: -20dB, -10dB, 0dB, +10dB(Ref), +20dB, +30dB, and +40dB.

4.4.7 BANDWIDTH (6dB)

Specifications:

BANDS 1-3 220Hz + 20Hz
BANDS 4-10 9kHz ± 1kHz
BANDS 11-15 120kHz ± 10kHz

Equipment used: Signal Generator; Frequency Counter (Optional)

NOTE: If a signal generator similar to the recommended HP8640B is utilized for this procedure, the frequency counter is not required.

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE . . . . BAND 3
COARSE TUNING Control . . . Set for 100kHz on the FREQUENCY DISPLAY
ATTENUATION setting . . . . -20dB

B. Using a signal generator, apply a 100kHz CW signal at a level of -20dBuV (0.1uV) to the RF INPUT of the CPR-25. Peak the signal generator for maximum on the front panel Linear scale. Use the front panel CAL GAIN Control, if necessary, to adjust the meter for a Full Scale (0dB) reading.

C. Increase the frequency of the signal generator until the front panel meter reads -6dB on the Linear scale. Record the frequency of the signal generator at this point.

D. Decrease the frequency of the signal generator through Full Scale to a -6dB reading again. Record the frequency of the signal generator at this point.

E. Subtract the frequency reading in step D from the reading in step C, the difference should equal 220Hz + 20Hz.

F. Repeat steps B thru C for BAND 6 at 800kHz. The CW signal input level is 0dBuV (1uV), the ATTENUATION DISPLAY should read 0dB, and the frequency difference (step E) should equal 9kHz ± 1kHz.

G. Repeat steps B thru E for BAND 11 at 37.5MHz. The CW signal input level is +10dBuV (3uV), the ATTENUATION DISPLAY should read +10dB, and the frequency difference (step E) should equal 120kHz ± 10kHz.

4.4.8 IMAGE AND IF REJECTION

Specification: Image and IF Rejection 45dB minimum.

Equipment used: Signal Generator (10kHz to 1000MHz).

4.4.8.1 IMAGE REJECTION

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

FREQUENCY RANGE ....BAND 1 to start
ATTENUATION setting.................. 0dB

B. Using a signal generator, apply a CW signal at the mid frequency point of BAND SEGMENT 1 (approx. 22kHz) at a level of 0dBuV (1uV) to the RF input of the CPR-25 Peak the signal generator for maximum on the front panel meter Linear scale. Adjust, if necessary, the meter for a Full Scale (0dB) reading using the front panel CAL GAIN Control.

C. Tune the signal generator to twice the IF Frequency for BAND SEGMENT 1 (175kHz) plus the indicated CPR-25 frequency.

For example: BAND 1 @ 22kHz = 372kHz.

D. Increase the input signal level approximately 30dB and peak the signal for maximum on the Linear scale. Increase the input signal level until the CPR-25 meter reads Full Scale (0dB). Record the input signal level increase required to obtain the Full Scale indication, which is equivalent to the IMAGE REJECTION level for BAND SEGMENT 1.

E. Repeat steps B thru D for the mid frequency points of BAND SEGMENTS 2-15 using the information given below:

BAND 2 and 3: Initial CW input signal level = 0dBuV (1uV)

IF FREQUENCY = 175kHz

ATTENUATION DISPLAY = 0dB

BAND 4-10: except BAND 7 Initial CW input signal level = +20dBuV (10uV)

IF REQUENCY = 1.6MHz

ATTENUTAION DISPLAY = +20dB

BAND 7: Same as for BANDS 4-10 except IF FREQUENCY = 175kHz.

BANDS 11-15: Initial CW input signal level = +30dBuV (30uV)

IF FREQUENCY: BAND 11 and 12 = 8.7MHz
BAND 13 = 8.7MHz
BAND 14 = 68.7MHz
BAND 15 = 98.7MHz

ATTENUATION DISPLAY = +30dB.

4.4.8.2 IF REJECTION

A. Set the CPR-25 front panel controls as per 4.4.8.1A.

B. Repeat the procedure given in 4.4.8.1 steps B thru E except for the following:

The signal generator is tuned to the 1st IF and 2nd IF (where applicable) frequencies of the band segment being checked. The 1st and 2nd IF Frequencies are given below:

BANDS 1-3: 1st IF FREQUENCY = 175kHz
2nd IF FREQUENCY = 1.6MHz
BANDS 4-10: 1st IF FREQUENCY = 1.6MHz
except BAND 7

BAND 7: 1st IF FREQUENCY = 175kHz
2nd IF FREQUENCY = 1.6MHz

BANDS 11 and 12: 1st IF FREQUENCY = 8.7MHz

BAND 13: 1st IF FREQUENCY = 38.7MHz
2nd IF FREQUENCY = 8.7MHz

BAND 14: 1st IF FREQUENCY = 68.7MHz
2nd IF FREQUENCY = 8.7MHz

BAND 15: 1st IF FREQUENCY = 98.7MHz
2nd IF FREQUENCY = 8.7MHz

4.4.9 SPURIOUS RESPONSE

A. Set the CPR-25 front panel controls as per 4.4.1 except for the following:

DETECTOR OUTPUT switch ....LOG
FREQUENCY RANGE ....BAND 1 to start
ATTENUATION setting.................. 0dB

B. Calibrate the receiver as per 4.4.2B.

C. With all input signals disconnected, slowly tune the CPR-25 through each band segment. Record the frequency and level above the receiver's sensitivity of all spurious responses.

SECTION V

Service, Maintenance and Calibration

5.1 GENERAL

This section provides the information necessary for the proper maintenance, calibration, troubleshooting, and repair of the CPR-25 Interference Analyzer. Failure to follow these procedures could violate the terms of the manufacturer's warranty, plus compromise the reliability, operation, and integrity of the instrument.

5.2 MAINTENANCE/CALIBRATION/REPAIR

5.2.1 MAINTENANCE

To ensure accurate and trouble-free operation of the CPR-25, it is recommended that a periodic maintenance schedule be initiated on a six month or 1000 hours of operational time basis. The performance test procedures of Section IV should be included as part of the maintenance procedure to assess the instrument's overall performance.

5.2.2 CALIBRATION

The calibration/alignment procedures of Section 5.7 are utilized as follows:

A. To align and recalibrate the instrument after repair work has taken place.

B. As part of the periodic maintenance schedule to maintain the accuracy of the instrument to the required specifications.

5.2.3 REPAIR

Repair of the instrument should be undertaken when one of the following conditions exists:

A. There is an obvious fault in the instrument's operation.

B. Operation is outside the specification limits and cannot be restored by recalibrating the CPR-25.

5.2.4 TEST EQUIPMENT REQUIRED

Table 5-1 lists the test equipment required for troubleshooting purposes and to perform the calibration/alignment procedures.

5.3 PRECAUTIONS

A. Always verify that the Power Source Switch setting corresponds to the AC power source being utilized (115VAC/230VAC). Operation on 230VAC with the switch set to 115VAC could cause extensive circuit damage.

B. Use caution when making "power on" measurement to prevent inadvertent shorts and possible damage to circuit components.

C. To prevent possible damage to circuitry and components, always turn off and disconnect the AC power source and the optional battery (if installed) whenever removing/replacing/servicing modules, subassemblies, PC boards, or components within the instrument.

5.4 TROUBLE-SHOOTING

5.4.1 TROUBLESHOOTING PROCEDURE

The procedure for troubleshooting the CPR-25 is similar to that employed for other electronic equipment. This consists of pinpointing the source/cause of the malfunction by the process of logically eliminating alternate possibilities. By eliminating the greatest number of possibilities with one check, this process will quickly narrow the remaining choices until the defective component or circuitry is isolated.

To facilitate troubleshooting the CPR-25, the Troubleshooting/Repair Sequence Guide and Table 5-2 (Common Faults chart) can be utilized as a guide. For any assistance required (troubleshooting, calibration, repair, general maintenance) contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT (518) 843-2600.

TABLE 5-1

RECOMMENDED TEST EQUIPMENT

Equipment	Performance Ratings	Recommendations[1]
SIGNAL GENERATOR	10kHz – 1000MHz Frequency Accuracy ±0.1% Amplitude Accuracy ±1.0% Output Level -20dBuV to +120dBuV Source Impedance to 50 ohms	HEWLETT PACKARD HP 8650B with 11710B Down converter
10dB STEP ATTENUATOR	Frequency Range DC to 1GHz Attenuation Range 0 to 120dB Accuracy ±0.5dB	HEWLETT PACKARD HP 355D
IMPULSE GENERATOR	Variable Repetition Rate 1-100MHz Calibrated Output Level 0 to 90dBuV/MHZ	ELECTRO-METRICS CIG-25
DIGITAL VOLTMETER	Range 0VDC to ±1000VDC Accuracy ±0.1% Input Impedance ≧ 10MEGOHM	DATA TECH
OSCILLOSCOPE	Frequency Range DC to 10MHz Sensitivity 10mV/DIV.	
DC POWER SUPPLY	Range 0 – 10VDC. Current Rating 500ma Variable current limiting	
FREQUENCY COUNTER[2] (Optional)	Calibrated Frequency Range 10kHz to 1GHz Accurate ≧ 0.1%	

Note: 1. Equivalent equipment can be substituted for those recommended.
2. Not required if the HP8640B or equivalent is utilized.

5.4.2 COMMON FAULTS (TABLE 5-2)

Table 5-2 lists the most common faults which may occur during the performance test procedures or during normal operational usage. Perform the checks in the order indicated on the table.

5.4.2.1 BATTERY TEST (OPTIONAL)

CPR-25 operation utilizing an optional battery pack as a sole power source should have the battery charge status checked periodically. The battery status is checked with the receiver turned on

TABLE 5-2

COMMON FAULTS

	CHECKS/TESTS (LEFT TO RIGHT)											
	Control Settings						Connections					
FAULT	Local Control	Manual Tune	Detector	Other	Battery-Test	Line Fuse	Power Cable	RF-Input Cable	Control Cable	Test Equipment Calibration	Check (A7J7) Voltages	Internal Access Required
1. Unit inoperative												
a. On battery only					X						X	X
b. All bands	X	X	X	X	X	X	X	X	X		X	X
c. One or more bands					X			X			X	X
d. "On" light won't light				X	X	X	X				X	X
e. Charge light off						X	X				X	X
f. Meter pins+			X		X						X	X
g. Meter pins–					X						X	X
h. Meter dead	X			X	X	X	X				X	X
i. Unit won't tune	X	X			X			X			X	X
j. Freq. display inop	X	X		X		X			X		X	X
2. Amplitude error												
a. All bands	X	X	X	X	X			X		X	X	X
b. One or more bands				X	X			X		X	X	X
c. Attenuator accuracy			X							X	X	X
d. Meter tracking			X		X					X	X	X
e. Can't calibrate	X				X						X	X
3. Frequency accuracy				X	X					X	X	X
4. Sensitivity				X	X			X		X	X	X
5. Bandwidth			X	X	X					X	X	X
6. Image/IF rejection				X	X					X	X	X
7. Spurious response				X	X					X	X	X
8. Powered accessories					X				X		X	X
9. Can't change bands	X				X	X	X				X	X

and the AC power source disconnected by pushing the front panel BATTERY TEST switch. If the front panel meter reads in the OPERATE section, the battery charge is sufficient to operate the receiver. If the meter reads in the LOW section, the battery requires recharging as per 3.8.1.3.2.

5.4.2.2 CONTROL SETTINGS

Always verify that the front panel controls settings are correct for the procedures and measurements being performed.

5.4.2.3 OPERATIONAL ERRORS

Operational errors can be avoided or minimized through a thorough familiarization with the Operating Instruments and explanations in Section III.

5.4.2.4 TEST EQUIPMENT ACCURACY

It is imperative that the test equipment accuracy be commensurate with the parameters being measured and that all sources of error be carefully computed.

5.4.2.5 REMOTE CONNECTOR VOLTAGES

To verify whether the internal voltage regulators are functioning correctly, check the voltages on the pins listed in Table 5-3 for the REMOTE connector (A7J7).

TABLE 5-3

REMOTE CONNECTOR VOLTAGES

Pin	DC Voltages
AA	GND
V	+12.0VDC ±0.1VDC
X	-6.0VD ±0.1VDC
CC	-12.0VDC ±1.0VDC
HH	+20.0V DC ±2.0VDC

5.5 REPAIR PROCEDURES

5.5.1 METHOD

A. Use the Troubleshooting/Repair Sequence Guide (Fig. 5.1 thru Fig. 5.4) to isolate the section of the instrument where the circuit malfunction is occurring and its cause.

B. Use the information obtained to determine whether to repair or replace the defective module, assembly, board, or component.

C. If the level of service is to replace the defective module/assembly/P.C. board; all assemblies, modules, and printed circuit boards are replaceable without affecting the overall characteristics and specification limits of the CPR-25, providing alignment and calibration is performed as per Section 5.7.

D. If the level of service is to repair the defective module/assembly/P.C. board; use the reference data in Section VI and the alignment and calibration procedure of Section V to reduce the malfunction down to an individual component/components. In addition, the Theory of Operation provides the operating principles and circuitry functions for the CPR-25 which can be utilized as an aid in troubleshooting or repairing the instrument.

After all repair functions have taken place, align and calibrate the CPR-25 as per Section 5.7.

E. After the alignment and calibration procedures have been completed, perform the Performance Test Procedures of Section IV to verify that the CPR-25 meets the receiver's specification limits.

5.5.2 PRINTED CIRCUIT BOARD PRECAUTIONS

A. Do not remove circuit boards (or any other components) while power is applied to the unit. Always turn off and disconnect all external power before proceeding.

B. Never touch the printed surface with bare fingers; skin oils can create leakage paths.

C. Use a grounded soldering iron (20W to 30W) to avoid destruction of 1C's and semiconductors.

D. Avoid excessive heat when repairing a P.C. board.

E. After all repair work is completed, clean the printed surface of all contaminants, excess solder, and resin using a freon-base cleaner. Check that excess solder has not created new circuit paths.

NOTE: After any general repair work, always clean the repair area with a freon-base or similar cleaner.

5.6 INSTRUMENT ACCESS/ DISASSEMBLY/ASSEMBLY

See Figures 6.1A and 6.1B LOCATION GUIDE, TOP and BOTTOM VIEWS.

CAUTION

Before proceeding with any of the procedures listed below, disconnect the AC power input on the rear of the unit.

5.6.1 TOP/BOTTOM COVER REMOVAL

5.6.1.1 TOP COVER REMOVAL

A. The unit is placed right side up.
B. Remove the eight retaining screws (4-40X3/16) that secures the cover to the unit.
C. Slide the cover back and out of the slots holding the cover in place.
D. To replace the cover, reverse the above procedure.

5.6.1.2 BOTTOM COVER REMOVAL

A. The unit is placed bottom side up.
B. Remove the four feet from the bottom cover.
C. Remove the eight retaining screws (4-40X3/16) that secures the cover to the unit.
D. Slide the cover back and out of the slots holding the cover in place.
E. To replace the cover, reverse the above procedure.

NOTE: After the bottom cover is removed, the units that have the optional battery pack installed should have the battery plug removed from the battery jack (A9J1) and inserted into the dummy receptacle provided. This will prevent accidental turn-on of the unit and inadvertent shorts.

5.6.2 SIDE PANELS REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the nine retaining screws which secures each side panel to its respective side of the unit. The panels are now free to be removed.
C. To replace the side panels, reverse the above procedure.

5.6.3 FRONT PANEL (A1) REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the side panels as per 5.6.2. (NOTE: The front panel can be removed if necessary with the side panels in place, however removal of the front panel is facilitated with the side panels removed.)
C. Remove the eight retaining screws (6-32X1) which secures the front panel to the unit.
D. Disconnect the miniature coaxial cable from the FREQUENCY DISPLAY Module connector (A1A3-J1) and the rigid coaxial cable from the LOW PASS FILTER connector (A1A2-J1) (open end 5/16 wrench required).
E. The front panel can now be laid flat on its face for the majority of normal maintenance work. If required, by disconnecting the nine 13 pin female connectors (A1-P2, P3, P6, P7, P8, P9, P10, P13) from the corresponding 13 pin male headers on the front bulkhead and the four coaxial cables (three miniature cable-1/4 wrench required, one BNC connector), the front panel can be completely removed from the unit.

NOTE: To facilitate removal of the 13 pin connectors, use a wide tip screwdriver to gently pry up first one then the other end of the connector. This should loosen the connector enough to allow it to be removed by hand using a gentle rocking motion.

F. To replace the front panel, reverse the above procedure.

5.6.4 OPTIONAL BATTERY (A9) INSTALLATION

A. Remove the bottom cover as per 5.6.1.2.
B. Insert the battery pack into the unit along side the CARD GUIDE RACK Assembly (A7A1) with the battery connector jack (A9J1) towards the rear of the unit.

C. Tighten the four quarter-turn fasteners to secure the battery pack into the unit.
D. Remove the battery plug from the dummy receptacle and insert it into the battery connector jack (A9J1).

NOTE: See Section 5.7.3.1 for the adjustment procedure for setting the battery charge rate.

5.6.4.1 OPTIONAL BATTERY (A9) REMOVAL

A. To remove the optional battery pack, reverse the procedure given in 5.6.4.

5.6.5 CARD RACK ASSEMBLY (A7A1) REMOVAL

A. Remove the bottom cover as per 5.6.1.2.
B. Loosen the six quarter-turn fasteners which secures the Card Rack Assembly to the unit.
C. Disconnect the seven 13 pin female connectors (A7A1-P1, P2, P3, P9, P10, P11, P15) from the corresponding 13 pin male header on the front bulkhead. (See 5.6.3E NOTE for method of removing 13 pin connector).
D. Disconnect the 22 pin fanning strip A7FS1 from the A7TB1 terminal block located at the rear of the unit.
E. Remove the two miniature coaxial cables on connectors A7J11 and A7J13 (open end 1/4 wrench required) (See Fig. 5.5). Using a 5/8 spin type remove the nuts securing BNC connectors A7J1 (AM VIDEO) and A7J2 (FM VIDEO) to the rear panel. (NOTE: Mark each cable to ensure correct placement when installing).
F. The Card Rack Assembly can now be lifted up and out of the unit.
G. To install a Card Rack Assembly, reverse the above procedure.

5.6.6 SUBMODULE ASSEMBLY (A3, A4, A5) REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the left side panel (as aligned on a front to rear axis) as per 5.6.2.
C. Remove the four subminiature coaxial cables from connectors A2J1-J4 on the RF Preselector (A2) Assembly. (See Fig. 5.33)
D. Remove the three subminiature coaxial cables from connectors A7J11-J13 (located at left rear of unit). (See Fig. 5.33)
E. Loosen and remove the three fanning strips (one for each module) A3FS3 (1-9), A4FS2 (14-17), and ASFS3 (10-19) from the A6TB2 (14-17) and A6TB3 (1-19) terminal blocks (See Fig. 6.1A) respectively.
F. Loosen the six quarter-turn fasteners which secures the three submodules (A3, A4, A5) into the unit.
G. Lift entire module assembly, carefully up and out of the unit.
H. Remove the brace which secures the individual modules together. The brace is secured to the Submodule Assembly package by six screws (4-40X3/16). Also disconnect all interconnecting subminiature coaxial cables between the modules.

NOTE: All subminiature coaxial cables referred to during this and other procedures for this section are removed utilizing a 1/4 inch open end wrench. In addition all cables are labelled to ensure correct placement.

I. To install the Submodule Assembly Package, reverse the above procedure except for the following:
The module brace is installed as the final step of the installation procedure.

5.6.7 RF ATTENUATOR (A2A18) REMOVAL

A. Remove the top cover as per 5.6.1.
B. To facilitate the removal of the RF Attenuator and to increase the working area, remove the IF/MIXER CONTROL (A6A2) and BAND CONTROL (A6A3) boards from their respective card guide brackets on the front of the Power Supply (A6) Assembly.
C. Remove the two rigid coaxial cables from the RF Attenuator (open end 5/16 wrench required).
D. Remove the two screws (4-40X5/8) which secures the RF Attenuator to its holding bracket on the RF Preselector Assembly.
E. Lift the RF Attenuator Assembly carefully up and away from its holding bracket until the solenoid drive plug can be reached. Press the plug at the arrow marked points using the thumb and finger, pull to detach. CAUTION: DO NOT TWIST THE PLUG. Damage to the plug wiring could result.
F. The RF Attenuator Assembly is now free from the unit.

G. To install the RF Attenuator Assembly, reverse the above procedure.

5.6.8 IMPULSE GENERATOR (A2A17) REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the left side panel as per 5.6.2.
C. Remove the Submodule Assembly as per 5.6.6.
D. Reaching in through the left side, remove the two rigid coaxial cables for the IG Assembly (Open end 5/16 wrench required).
E. Loosen and remove the IG fanning strip A2FS4(15-19) from the A6TB4(15-19) terminal block. (NOTE: One or more cable ties may have to be cut to remove the IG wiring cable from the main RF Preselector Assembly cable harness).
F. Remove the two screws (6-32X5/8) which secures the IG to its holding bracket on the RF Preselector Assembly.
G. Carefully lift the IG up and out of the unit.
H. To install an Impulse Generator Assembly, reverse the above procedure.

NOTE: Another method of removing an IG, is to remove the entire RF Preselector Assembly as per 5.6.10. Proceed as above except for fanning strip removal.

5.6.9 RF PRESELECTOR (A2) COVER REMOVAL

A. Remove the top cover as per 5.6.1.1.
B. Remove the 14 flat-screws (6-32X7/16) on the rear side of the Preselector cover.
C. Remove the four flat-head screws (6-32X7/16) on the rear side of the cover. These screws will have to be removed using either a stubby (2 inch overall length max.) or right-angle screwdriver. For greater accessability, remove the IF/MIXER CONTROL (A6A2) and BAND CONTROL (A6A3) boards from their respective and card guides on the front of the A6 Power Supply Assembly.
D. The cover can now be lifted up and off the Preselector Assembly.
E. To replace the RF Preselector cover, reverse the above procedure except for the following: Verify that the lower edge of the cover slips inside the channel formed by the bottom cover of the Preselector Assembly.

5.6.10 RF PRESELECTOR (A2) ASSEMBLY REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the side panels as per 5.6.2.
C. Remove the five subminiature coaxial cables from connector A2J1-J4, J7 on the side of the Preselector Assembly (open end 1/4 wrench required).
D. Completely remove the rigid coaxial cable from connector A8J21 on the front bulkhead to connector A2J5 on the side of the Preselector Assembly (5/16 open end wrench required).
E. Remove the rigid coaxial cable fron connector A2A18-J1 located on the RF Attenuator Assembly (this is the rigid coaxial cable from the front panel bulkhead routed on the right side of the unit) (5/16 open end wrench required).
F. Loosen and remove the three fanning strips for the RF Preselector Assembly: A2FS1(1-19), A2FS2(1-13), and A2FS4 (15-19) from the A6TB1(1-19), A6TB2(1-13), and A6TB4(15-19) terminal blocks respectively.
G. Remove the four screws (8-32X5/9) which secures the RF Preselector Assembly to the unit. The one screw is located on the right front corner of the assembly secured through a holding bracket, it is removed through the side. The other three screws are located at the other three corners of the assembly and require the use of a screwdriver with a minimum shaft length of six inches and a 1/4 inch minimum blade width for removal.
H. The RF Preselector Assembly can now be carefully lifted up and out of the unit.
I. To remove the upper preselector cover, refer to 5.6.9.
J. To install an RF Preselector Assembly, reverse the above procedure.

5.6.11 FREQUENCY DISPLAY MODULE (A1A3) REMOVAL

A. Remove the top and bottom covers as per 5.6.1.
B. Remove the front panel as per 5.6.3 (partial removal only).
C. Remove the two 13 pin female connectors A1P7 and A1P8 from the corresponding 13 pin male headers on the front bulkhead (see 5.6.3 E NOTE for method of removing 13 pin connector). In a similar manner, remove the 6 pin

female connector A2A8P1 from the corresponding 6 pin male header on the BAND INDICATOR DRIVER and DISPLAY (A1A8) board.

D. Cut the cable ties on the front panel main wiring harness in order to remove the FREQUENCY DISPLAY Module's wiring harness.

E. Carefully remove the six screws (4-40X1/2) which secures the module to the front panel.

F. The FREQUENCY DISPLAY Module is now free from the front panel.

G. To install a FREQUENCY DISPLAY Module, reverse the above procedure.

5.6.12 RF INPUT LOW PASS FILTER (A1A2) REMOVAL

A. Remove the top and bottom covers as per 5.6.1.

B. Remove the front panel as per 5.6.3 (partial removal only).

C. Remove the nut which secures the LOW PASS FILTER to the front panel using a 5/8 inch spin-type.

D. The LOW PASS FILTER assembly is now free to be removed from the front panel.

E. To install an RF INPUT LOW PASS FILTER, reverse the above procedure.

5.6.13 POWER SUPPLY MODULE (A6A) REMOVAL

A. Remove the four screws (one in each corner) which secures the module into the Power Supply Assembly (A6).

B. Pull the Power Supply Module A6A1 away and out from the compartment in the Power Supply Assembly A6 until the connecting plug on he rear of the module is accessable.

C. Twist the retaining ring on the plug to rotate it out of its locked position. Remove the female plug (A6A1P3) from its corresponding male jack (A6A1J3) located on the Power Supply Module.

D. The Power Supply Module is now free from the unit.

E. To install a Power Supply Module, reverse the above procedure.

5.7 CALIBRATION/ALIGNMENT PROCEDURES

5.7.1 GENERAL

This section contains the calibration/alignment procedures which are normally utilized to recalibrate/align the CPR-25 after repair/replacement work has been performed or when the performance test procedures of Section IV indicates that the receiver does not meet unit specifications.

5.7.1.1 The following procedures are performed with the POWER SOURCE switch set to the 115VAC position and the unit connected to a 115VAC, 50-60Hz AC power source.

5.7.1.2 It is recommended that the following be utilized when performing the calibration/alignment procedures:

A. The information in Section II (THEORY OF OPERATION) – explanation of circuitry operation and function.

B. The information in Section VI (REFERENCE DATA) – schematic diagrams, location guides (main unit views), and recommended spare parts list.

C. The PC board layout diagrams (Fig. 5.5 – 5.32) which indicate major components IC's, transistors), adjustable resistors (when present), and terminals (when present) plus terminal designation and function.

5.7.2 INITIAL CONTROL SETTINGS

Initial set the CPR-25 front panel controls as follows:

LOCAL/REMOTE Switch	LOCAL
DETECTOR FUNCTION Switch	QUASI-PEAK
DETECTOR OUTPUT Switch	LINEAR
TUNING CONTROL Mode	MANUAL
FREQUENCY DISPLAY Switch	ON
AFC Switch	OFF
COARSE TUNING Control	MID-RANGE to start
FINE TUNING Control	MID-RANGE (Mechanical center)

NOTE: To perform the calibration/alignment procedures described in the following paragraphs, it is necessary to remove the top and bottom covers of the unit (see 5.6.1).

5.7.3 POWER SUPPLY VERIFICATION

Equipment used: Digital Voltmeter

A. Set the CPR-25 front panel controls as per 5.7.2.

B. Turn the unit upside down and locate Terminal Block A7TB1 at the rear of the CARD RACK Assembly A7A1 (see Fig. 6.1B).

C. Use the Digital Voltmeter to measure the voltage for the A7TB1 pins listed in Table 5-4.

D. ADJUSTMENTS: If any of the voltages measured and designated adjustable are out of specification limits, adjust as follows:

1. Adjust A6A1A1-R3 for a reading of +20.0VDC.
2. Adjust A6A1A1-R18 for a reading of -12.0VDC. A6A1A1 is the designation for the POWER SUPPLY PC board located in the Power Supply Module A6A1.
3. Adjust A7A1A12-R18 for a reading of +12.0VDC.
4. Adjust A7A1A12-R20 for a reading of -6.0VDC. A7A1A12 is the designation for the BATTERY CHARGER AND LOW VOLTAGE CUTOFF PC board located in the CARD RACK assembly (A7A1).

5.7.3.1 OPTIONAL BATTERY CHARGER ADJUSTMENT

Additional equipment required: 22 pin double-sided extension board (ECB-25C)

NOTE: Before proceeding with the following procedure, disconnect the AC power source from the receiver and with the unit turned off for at least 8-10 hours to allow the battery temperature to obtain the nominal ambient temperature.

A. Turn off and disconnect the unit from the AC power source.

B. Remove the BATTERY CHARGER AND CUTOFF board (A7A1A12) from its connector in the CARD RACK assembly (A7A1) and insert a 22 pin double-sided extension board with a 68K resistor between pins 1 & 2 and pin 4. Disconnect the battery during this step.

C. Insert the BATTERY CHARGER and CUTOFF board into the extender board and monitor the voltage across resistor A7A1A12-R9 (15ohm 2W) with the voltmeter.

D. Reconnect the battery and the unit to the AC power source, the unit remains off for this procedure.

E. Adjust A7A1A12-R3 (Battery Charge Rate Adjust) for a voltmeter reading of 1.5VDC, which is equivalent to a 100Ma charge rate.

F. After the above adjustment has been completed, disconnect the battery and the AC power source. Remove the extender board and reinsert the BATTERY CHARGER and CUTOFF board back into its connector. The unit is now set for normal operation.

5.7.4 LOG CIRCUITRY ADJUSTMENTS

Equipment used: Digital Voltmeter (2 required)
10dB Step Attenuator
0-10VDC Power Supply
22 pin double-sided extension board (ECB-25C)

This procedure covers the adjustment of the LOG AMPLIFIER board (A7A1A4) and the PEN

TABLE 5-4

VOLTAGE CHECK POINTS A7TB1

A7TB1 Terminal Designation	DC Voltage	Specification Limits	Adjustable
13	+12.0VDC	±0.1VDC	Yes — see D-3
14	-6.0VDC	±0.1VDC	Yes — see D-4
15	HV RAW +150VDC	+140 to +160VDC	No
16	+RAW +20.0VDC	±0.5VDC	Yes — see D-1
17	- RAW - 12.0VDC	±0.5VDC	Yes — see D-2

#2 DRIVER board (A7A1A5) located in the CARD RACK ASSEMBLY (A7A1).

NOTE: Adjustment of the PEN #2 DRIVER board (A7A1A5) should proceed simultaneously with that of the LOG AMPLIFIER board (A7A1A4), since certain adjustments on the PEN #2 board will affect some offset voltages on the LOG board.

5.7.4.1 LOG AMPLIFIER BOARD (A7A1A4) ADJUSTMENT

To facilitate the following adjustments, the unit should be set on its left side (CARD RACK Assembly side of lower compartment).

5.7.4.1.1 LINEAR ADJUSTMENT

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

DETECTOR FUNCTION switch . . . . . . RMS
FREQUENCY RANGE . . . . BAND 11

B. Remove the Log Amplifier board from its connector in the CARD RACK Assembly. Mount it on the 22 pin double-side extender board and inset the combination back into the board's connector.

C. Connect the positive output of the DC power supply through a 50 ohm resistive load to the input of the 10dB step attenuator. Connect the output of the step attenuator to the Log Amplifier board A7A1A4-A (RMS INPUT). Use the two BNC to clip leads cables for this setup with the 50 ohm resistive load in line with the positive line of the DC power supply output.

⊕A+P⊛

D. Remove the RMS DETECTOR (A7A1A1), PEAK DETECTOR (A7A1A2), and QUASI-PEAK/CARRIER DETECTOR (A7A1A3) boards from their connectors in the CARD RACK Assembly. This will prevent loading of the DC voltage input during the procedure which could cause erroneous readings.

E. Set the 10dB step attenuator for 40dB of attenuation. Turn on the CPR-25 and the DC power supply. Using the digital voltmeter, adjust the DC power supply for a reading of 0.115VDC on A7A1A4U6-3 (LINEAR AMPLIFIER). DC Supply = [illegible]

NOTE: All measurements made utilizing the digital voltmeter are, unless otherwise indicated, between ground and the point of measurement for this and all following procedures.

F. Change the external step attenuator to 60dB of attenuation and adjust A7A1A4-R55 (LIN ZERO) for -20dB on the Linear scale of the front panel meter.

G. Change the external step attenuator to 40dB of attenuation and adjust A7A1A4-R56 (LIN GAIN) for a Full Scale (0dB) reading on the Linear scale.

H. Repeat steps F and G until no further readjustments are necessary. Check the -10dB position on the Linear scale by setting the external step attenuator for 50dB of attenuation. Some compensation utilizing R55 and R56 may be necessary for the Full Scale, -10dB, and -20dB positions to meet the specification limit of ±2.0dB.

5.7.4.1.2 LOG ADJUSTMENT

A. Turn off the CPR-25 and the DC power supply. Temporarily connect a 10K 1/4w resistor between A7A1A4U3-2 and A7A1A4U3-7 and adjust A7A1A4-R5 full CW.

B. Turn on the CPR-25 and the DC power supply. Using the digital voltmeter, adjust A7A1A4-R15 (LOG BAL) for a reading of 0VDC on A7A1A4U3-7. After the adjustment is completed, remove the 10K resistor (power off-CPR-25/DC power supply).

C. Set the DETECTOR OUTPUT switch to the ZERO position, the ZERO control to a mid-range mechanical position, and the external step attenuator for 10dB of attenuation.

D. Turn on the CPR-25 and the DC power supply, adjust A7A1A4-R20 (BAND 11-15 OFFSET) for a 0dB reading on the front panel meter Log scale.

E. Change the external step attenuator to 120dB of attenuation, the meter should still indicate a 0dB reading. If not, recheck the adjustment procedure in steps A and B.

F. Change the DETECTOR OUTPUT switch to the LOG position and the external step attenuator to 10dB of attenuation.

G. Connect the digital voltmeter to A7A1A4-21 and adjust A7A1A4-R24 for a reading of 1.50VDC. Next adjust A7A1A4-R40 (METER CAL) for a Full Scale (+40dB) reading on the front panel meter Log scale.

H. Change the external step attenuator to 40dB of attenuation, readjust A7A1A4-~~R20~~ R43 (BANDS 11-15 OFFSET) for +10dB on the Log scale.

I. Change the external step attenuator to 10dB of attenuation, readjust A7A1A4-R24 for a Full Scale (+40dB) reading on the Log scale.

J. Repeat steps H and I, checking the intermediate positions (+30, +20, etc.), until the Log scale meets the specification limits of ±2.0dB.

K. Set the external step attenuator for 40dB of attenuation, change the FREQUENCY RANGE to BAND 3, and the DETECTOR OUTPUT switch to the LINEAR position. The front panel meter should read Full Scale on the Linear scale.

L. Change the DETECTOR OUTPUT switch to the LOG position and adjust A7A1A4-R26 (BANDS 1-3 OFFSET) for -20dB on the Log scale.

M. Change the DETECTOR OUTPUT switch to the LINEAR position and the FREQUENCY RANGE to BAND 6, the front panel meter should read Full Scale on the Linear scale.

N. Change the DETECTOR OUTPUT switch to the LOG position and adjust A7A1A4-R30 for 0dB on the Log scale.

O. Recheck over the meter scale positions for the LOG and LINEAR positions of the DETECTOR OUTPUT switch for the FREQUENCY RANGE settings of BAND 3 (BAND 1-3 logic group), BAND 6 (BANDS 4-10 logic group), and BAND 11 (BANDS 11-15 logic group). For equal input levels the following should occur:

   1. In LINEAR, the meter readings will be equal for all Band Logic Groups (1-3, 4-10, 11-15).
   2. In LOG, the meter readings should be as follows: compared to BANDS 1-3: BANDS 11-15 will be 30dB higher, while BANDS 4-10 will be 20dB Higher.

P. If the Log scale cannot be adjusted to meet specification limits, either A7A1A4-R20 (BANDS 11-15 OFFSET) may have to be readjusted or the ZERO OUTPUT alignment procedure recheck and redone (steps A thru E).

5.7.4.2 PEN #2 DRIVER BOARD (A7A1A5) ADJUSTMENT

NOTE: As noted above: Alignment of the PEN # Driver board should be done simultaneously with that of the LOG Amplifier board due to loading effects between the boards. The RMS input to the PEN #2 Driver board (A7A1A5-9) and to the Log Amplifier board (A7A1A4-A) are connected internally within the unit. Thus the DC voltage applied to the RMS input during the alignment procedure for the Log Amplifier board is simultaneously applied to the RMS input of the PEN #2 Driver board.

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

DETECTOR FUNCTION switch . . . . RMS
DETECTOR OUTPUT switch . . . . LOG
FREQUENCY RANGE . . . . BAND 11
PEN #2 SWITCH . . . . RMS

B. Turn off the CPR-25 and disconnect the DC input to A7A1A4-A. Remove the PEN #2 DRIVER board from its connector in the CARD RACK Assembly, mount it on the 22 pin double-rided extender board and insert the combination back into the board's connector. Temporarily connect a 10K ¼W resistor between A7A1A5U1-2 and A7A1A5U1-7 and adjust A7A1A5-R14 (BIAS) to its mechanical center.

C. Turn on the CPR-25 power and using a digital voltmeter, adjust A7A1A5-R11 (ZERO) for a reading of 0.00VDC on A7A1A5U1-7. After the adjustment is completed, remove the 10K resistor (Power off-CPR-25).

D. Set the external step attenuator for 40dB of attenuation and reconnect the DC input to A7A1A4-A. The front panel meter should read +10dB on the Log scale.

E. Connect a digital voltmeter to the PEN #1 output of the Log Amplifier board A7A1A4-21 and another digital voltmeter to the PEN #2 output of the PEN #2 Driver board A7A1A5-20.

F. Adjust A7A1A5-R4 (BANDS 11-15 OFFSET) so that both voltmeter readings are equal.

G. Set the external step attenuator for 10dB of attenuation, the front panel meter should read Full Scale (+40dB) on the Log scale.

H. Adjust A7A1A5-R6 (LOG GAIN) for equal readings on the voltmeters.

I. Due to interactions between adjustments, repeat steps D thru H until no further readjustments are necessary. It may be necessary to utilize (A7A1A5-R14) (BIAS) for making minor adjustments at the low end of the Log scale in order to match the two voltmeter readings within 19mV at all points checked on the Log scale. This will ensure that the two PEN outputs will be matched within ±1.0dB.

J. Set the FREQUENCY RANGE to BAND 6 and the external step attenuator for 40dB of attenuation. The front panel meter should read +10dB on the Log scale.

K. Adjust A7A1A5-R17 (BANDS 1-10 OFFSET) for equal readings on the two voltmeters. Some compromise may be necessary between A7A1A5-R17, R4, R6 and R14 to maintain tracking across the Log scale and between Band Group 1-10 and 11-15. The difference between the two voltmeter outputs should in no instance be greater than 19mV.

L. Set the DETECTOR OUTPUT switch to the LINEAR position and the external step attenuator for 40dB of attenuation. The frontpanel meter should read Full Scale (0dB) on the Linear scale. The voltmeters readings should be equal for both PEN outputs.

5.7.5 DETECTION CIRCUITRY ADJUSTMENTS

Equipment used: Digital Voltmeter
10dB Step Attenuator
0-10VDC Power Supply
22 pin double-sided extension board (ECB-25C

This procedure covers the adjustment of the RMS DETECTOR (A7A1A1), PEAK DETECTOR (A7A1A2), and QUASI-PEAK/CARRIER DETECTOR (A7A1A3) boards plus the LINEAR DETECTOR Module (A4).

NOTE: The procedures for the RMS, PEAK, and QUASI-PEAK (CARRIER boards utilize the same DC input voltage level set as per step 5.7.4.1.1E (0.115VDC on A7A1A4U6-3).

Insert all three Detector Boards (RMS, PEAK, Q.P./CARR.) into the CARD RACK Assembly (A7A1). There are two methods by which to apply the DC alignment voltage to the three Detector boards:

Method 1: Use the BNC to clip lead cable and in conjunction with the extension board, clip the input cable onto the individual video input for each Detector board as follows:

PEAK (A7A1A2) input: A7A1A2-4, GND A7A1A2-2
RMS (A7A1A1) input: A7AA1-17, GND A7A1A1-16
Q.P./CARR (A7A1A3) input: A7A1A3-1, GND A7A1A3-2

Method 2: Use a BNC to subminiative coaxial cable from the external step attenuator (BNC) to connector A7J11 (subminiature), video output from the LINEAR DETECTOR Module A4, located in the upper compartment (see Fig. 5.33).

In the following procedures, the PEAK DETECTOR board must be aligned first since it is utilized as the reference to which the other two detector boards are aligned to.

5.7.5.1 PEAK DETECTOR BOARD (A7A1A2) ADJUSTMENT

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

DETECTOR FUNCTION Switch ....PEAK
FREQUENCY RANGE ....BAND 11

B. Remove the PEAK board from its connector in the CARD RACK Assembly. Mount it onto the 22 pin extension board and insert the combination back into the connector.

C. Utilize either Method 1 or 2 to apply the DC alignment voltage to the PEAK DETECTOR board.

D. When A7A1A2U3-3 is temporarily grounded, A7A1A2U3-7 should read 0.00VDC (measured utilizing a digital voltmeter). If not, adjust A7A1A2-R17 (PEAK ZERO) to attain this reading. After the measurement/adjustment is completed, remove the ground.

E. Set the external step attenuator for 40dB of attenuation, the front panel meter should read Full Scale (0dB) on the Linear scale. If the meter does not read Full Scale, adjust the DC power supply slightly to obtain a Full Scale reading.

F. Set the external step attenuator for 60dB of attenuation and adjust A7A1A2-R4 (DET. ZERO) for a -20dB reading on the Linear scale.

G. Recheck the Full Scale and -10dB meter positions with the external step attenuator set for 40dB and 50dB of attenuation respectively. It may be necessary in some instances, to adjust the DC power supply again for a Full Scale meter reading. If this is the case, readjust

A7A1A2-R4 for the -20dB meter position again. After adjustment of the PEAK DETECTOR board is completed, do not change the DC power supply voltage output level again.

H. Temporarily ground A7A1A2U2-3 and verify that A7A1A2U2-6 reads 0.00VDC (measured utilizing a digital voltmeter). If not, adjust A7A1A2-R14 (DISCHARGE ZERO) to attain this reading. After the measurement/adjustment is completed, remove the ground.

5.7.5.2 QUASI-PEAK/CARRIER DETECTOR BOARD (A7A1A3) ADJUSTMENT

A. Set the CPR-25 front panel controls as per 5.7.5.1 except for the following:

DETECTOR FUNCTION Switch . . .QUASI-PEAK

B. Set the external step attenuator for 60dB of attenuation and adjust A7A1A3-R24 (Q.P. ZERO) for a -20dB reading on the front panel meter Linear scale.

C. Set the external step attenuator for 40dB of attenuation and adjust A7A1A3-R26 (Q.P. GAIN) for a Full Scale (0dB) reading on the Linear scale.

D. Repeat steps B and C until no further adjustments are necessary.

5.7.5.3 RMS DETECTOR BOARD (A7A1A1) ADJUSTMENT

A. Set the CPR-25 front panel controls as per 5.7.5.1 except for the following:

DETECTOR FUNCTION Switch . . . . RMS

B. Set the external step attenuator for 60dB of attenuation and adjust A7A1A1-R14 (RMS ZERO) for a -20dB reading on the front panel Linear scale.

C. Set the external step attenuator for 40dB of attenuation and adjust A7A1A1-R10 (RMS GAIN) for a Full Scale (0dB) reading on the Linear Scale.

D. Repeat steps B and C until no further adjustments are necessary.

NOTE: Recheck all three Detector boards (PK, Q.P./CARR, RMS) for proper tracking across the Linear scale of the front panel meter. Compromise between the -20dB and -10dB position, if necessary, to meet the unit specification limit of ±2.0dB.

5.7.5.4 LINEAR DETECTOR MODULE (A4) ADJUSTMENT

Additional equipment required: Signal Generator.

The LINEAR DETECTOR Module (A4) is located in the upper compartment of the CPR-25 (See Fig. 6.1A).

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

DETECTOR FUNCTION Switch . . . . .PEAK
CAL GAIN Control . . . . FULL CW.
FREQUENCY RANGE . . . . BAND 11

B. The LINEAR DETECTOR Module (A4) must be removed from the Submodule Assembly package in order to perform the following procedure. Refer to the general procedure given in 5.6.6, removing only the LINEAR DETECTOR Module. The module's fanning strip should remain connected to the A6 terminal block, remove the input and output cables from their respective connectors (INPUT-A4J1, OUTPUT-A4J4). Remove the module's top cover (identified by the alignment holes) by removing the screws which secure the cover to the module. Place the module on a piece of masonite or similar material laid across the top of the remaining two modules and the edge of the unit.

C. Connect a digital voltmeter to the DC output of the LINEAR DETECTOR, either connector A4J4 (DC/VIDEO OUTPUT) or A4A1-E8 which is located on the internal A4A1 PC board.

D. With no signal input and A~~5~~4A1U3-2 temporarily grounded, the digital voltmeter should read 0.000VDC, if not adjust A4A1-R26 (LINEAR BAL). After this measurement/adjustment is completed, remove the ground.

E. Again with no signal input, the digital voltmeter should read approximately +0.0005VDC, if not adjust A4A1-R33 (BIAS CONTROL).

F. Connect a signal generator to connector A4J1 (1.6MHz IF INPUT) and apply a 1.600MHz signal at an input level of 40mV.

G. The digital voltmeter should read +5.000VDC, if not adjust A4A1-R44 (LINEAR GAIN).

H. Verify that transformer A4A1-T1 is peaked at this frequency and input level.

I. Reduce the signal input level to 30mV and verify that transformer A4A1-T2 is peaked at this input level.

J. Reconnect the output connector (A4J4) to bulkhead connector A7J11.
K. Set the signal input level to 60dBuV (1mV), the front panel meter should read Full Scale (0dB ±2.0dB on the Linear scale).
L. Reduce the CAL GAIN Control CCW until the meter reads -10dB on the Linear scale.
M. Increase the signal input level to 70dBuV (3mV), the meter should read Full Scale (0dB) ±2.0dB on the Linear scale. If within ±2.0dB of Full Scale, adjust A4A1-R44 (LINEAR GAIN for a Full Scale reading). If greater than ±2.0dB, recheck steps D thru I.
N. Return the LINEAR DETECTOR Module to its normal secured status when adjustments are completed.

NOTE: Table 5-5 contains a listing of the terminal functions for the A6TB1-A6TB4 terminal blocks located on the top of the A6 Power Supply Module. The four major assemblies (Preselector A2, IF Amplifier A3, Linear Detector A4, Mixer A5) located in the upper compartment are connected to these terminal blocks.

5.7.6 IF AMPLIFIER CIRCUITRY ADJUSTMENTS

NOTE: The IF Amplifier circuitry (A3A1, A3A2) alignment is extremely stable and should not be disturbed unless one or more of the frequency determining elements have been replaced. The procedure which follows applies only to the re-alignment of a previously operative IF Amplifier. Initial factory alignment is considerably more complex.

Equipment used:
Signal Generator
10dB Step Attenuator (Optional)
Frequency Counter (Optional)
Sweep Oscillator (Optional) Minimum
Requirements:
Frequency range 1 to 10 MHz.
Oscilloscope (Optional)

The following procedure covers the adjustment of the two IF amplifier circuits (A3A1-1.6 MHz, A3A2-8.7MHz) located in the IF AMPLIFIER/DISCRIMINATOR Module (A3). The procedure for each IF amplifier circuit contains two methods by which to align the IF circuitry. Either method will produce the same results, the method chosen will depend on each individual company's requirements and facilities.

5.7.6.1 A3 MODULE REMOVAL/ PREPARATION

A. The IF AMPLIFIER/DISCRIMINATOR Module (A3) must be removed from the Submodule Assembly package in order to perform the following procedure.
B. Refer to the general procedure given in 5.6.6, removing only the IF AMPLIFIER/DISCRIMINATOR Module (A3). The Module's fanning strip should remain connected to the A6 terminal block, remove the two input cables from their respective connectors (A3K1-1.6MHz IF INPUT, A3J2-8.7MHz IF INPUT). Whether the output cable is removed (A3J4-1.6MHz IF OUTPUT) will depend on the method chosen to align the IF Amplifiers. The cable connected to the Discriminator circuit (A3A3) output connector (A3J5-FM OUTPUT) must be removed, due to its short length, in order to allow removal of the module from the subassembly package.
C. Unless otherwise indicated, all adjustments are made within the top and bottom covers secured to the module (alignment holes are provided for all adjustments required).
D. Place the module on a piece of masonite or similar material laid across the top of the remaining two modules and the edge of the unit.

5.7.6.2 1.6MHz IF (A3A1) ALIGNMENT

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE .... BAND 6
CAL GAIN Control .... Set to 10dB reserve gain as established in 5.7.5.4 step L.
ATTENUATION Setting 0dB

B. Method 1 Alignment Procedures.
   1. Using a signal generator, apply an input signal of 1.6000MHz at a level of 10dBuV (3uV) to the 1.6MHz IF INPUT (A3J1). The output connector A3J4 (1.6MHz IF OUTPUT) should be connected via a subminiature coaxial cable to the input connector (A4J1) of the LINEAR DETECTOR Module (A4).

TABLE 5-5

A6 TERMINAL BLOCKS INFORMATION

A6 Terminal Block Designation	Terminal Function
A6TB1-1	CAL LOGIC COMMON (GND)
A6TB1-2	BANDS 1-3 +12VDC SWITCHED
A6TB1-3	BANDS 4-6, 8-10 +12VDC SWITCHED
A6TB1-4	BAND 7 +12VDC SWITCHED
A6TB1-5	BANDS 1-3 CAL LOGIC COMMAND (GND)
A6TB1-6	BANDS 4-7 CAL LOGIC COMMAND (GND)
A6TB1-7	BANDS 8-9 CAL LOGIC COMMAND (GND)
A6TB1-8	BAND 10 CAL LOGIC COMMAND (GND)
A6TB1-9	BANDS 11-12 CAL LOGIC COMMAND (GND)
A6TB1-10	BAND 13 CAL LOGIC COMMAND (GND)
A6TB1-11	BAND 14 CAL LOGIC COMMAND (GND)
A6TB1-12	BAND 15 CAL LOGIC COMMAND (GND)
A6TB1-13	+ RAW +20VDC NOMINAL
A6TB1-14	CLUTCH + VOLTAGE (+20VDC NOMINAL)
A6TB1-15	CLUTCH-VOLTAGE (–12VDC NOMINAL)
A6TB1-16	MOTOR + VOLTAGE (+20VDC NOMINAL)
A6TB1-17	MOTOR-VOLTAGE (12VDC NOMINAL)
A6TB1-18	DETENT SWITCH COMMON +20VDC or GND
A6TB1-19	DETENT SWITCH NC GND
A6TB2-1	ATTENUATOR DRIVE BD GND
A6TB2-2	+RAW (+20VDC NOMINAL) TO ATTENUATOR DRIVE BOARDBAND
A6TB2-3	+ HIGH VOLTAGE RAW 150VDC NOMINAL
A6TB2-4	+12VDC REGULATED
A6TB2-5	–6VDC REGULATED
A6TB2-6	BAND CODE 1 LOGIC OUT +12VDC NOMINAL
A6TB2-7	BAND CODE 2 LOGIC OUT +12VDC NOMINAL
A6TB2-8	BAND CODE 4 LOGIC OUT +12VDC NOMINAL
A6TB2-9	BAND CODE 8 LOGIC OUT +12VDC NOMINAL
A6TB2-10	BAND CODE LOGIC COMMON +12VDC NOMINAL
A6TB2-11	10dB LOGIC COMMAND RF ATTEN. +6VDC NOMINAL
A6TB2-12	20dB LOGIC COMMAND RF ATTEN. +6VDC NOMINAL
A6TB2-13	40dB LOGIC COMMAND RF ATTEN. +6VDC NOMINAL
A6TB2-14	CAL GAIN CONTROL INPUT +7VDC TO +12VDC
A6TB2-15	+ RAW (+20VDC) to LINEAR DETECTOR A4 MODULE
A6TB2-16	–RAW (–12VDC) to LINEAR DETECTOR A4 MODULE
A6TB2-17	+12VDC REGULATED TO LINEAR DETECTOR A4 MODULE
A6TB2-18	–6VDC REGULATED
A6TB2-19	+ HIGH VOLTAGE RAW 150VDC NOMINAL

TABLE 5-5 (cont'd)

A6 TERMINAL BLOCKS INFORMATION

A6 Terminal Block Designation	Terminal Function
A6TB3-1	+12VDC REG. TO IF/DISC. A3 MODULE
A6TB3-2	-6VDC SWITCHED BANDS 1-10 to A3 MODULE
A6TB3-3	-6VDC SWITCHED BANDS 11-15 to A3 MODULE
A6TB3-4	- RAW (- 12VDC) to IF/DISC. A3 MODULE
A6TB3-5	BANDS 1-3 LOGIC COMMAND (†12VDC) to A3
A6TB3-6	BANDS 4-10 LOGIC COMMAND (+12VDC) to A3
A6TB3-7	0dB IF ATTEN. LOGIC COMMAND (–6 to +0.5VDC) to A3
A6TB3-8	10dB IF ATTEN. LOGIC COMMAND (–6 to +0.5VDC) to A3
A6TB3-9	20dB IF ATTEN. LOGIC COMMAND (–6 to +0.5VDC) to A3 BANDS 11-15 CAL OR REMOTE ONLY
A6TB3-10	GND TO MIXER A5 MODULE
A6TB3-11	+12VDC REGULATED TO MIXER A5 MODULE
A6TB3-12	BANDS 1-3 +12VDC SWITCHED TO A5 MODULE
A6TB3-13	BANDS 4-6, 8-10, +12VDC SWITCHED TO A5 MOD.
A6TB3-14	BAND 7 +12VDC SWITCHED TO MIXER A5 MODULE
A6TB3-15	BANDS 11-12 –6VDC SWITCHED TO MIXER A5 MODULE
A6TB3-16	BAND 13 –6VDC SWITCHED TO MIXER A5 MODULE
A6TB3-17	BAND 14 –6VDC SWITCHED TO MIXER A5 MODULE
A6TB3-18	BAND 15 –6VDC SWITCHED TO MIXER A5 MODULE
A6TB3-19	BANDS 4-10 LOGIC COMMAND (+12VDC) OUT
A6TB4-1	BAND CODE 1 LOGIC OUT (+12VDC) to A1A3 (FREQ. DISPLAY)
A6TB4-2	BAND CODE 2 LOGIC OUT (+12VD C) to A1A3 (FREQ. DISLAY)
A6TB4-3	BAND CODE 4 LOGIC OUT (+12VDC) to A1A3 (FREQ. DISPLAY)
A6TB4-4	BAND CODE 8 LOGIC OUT (+12VDC) to A1A3 (FREQ. DISPLAY)
A6TB4-5	0dB IF ATTEN. COMMAND (–6 to +0.5VDC) OUT
A6TB4-6	10dB IF ATTEN. COMMAND (–6 to +0.5VDC) OUT
A6TB4-7	20dB IF ATTEN. COMMAND (–6 to +0.5VDC) OUT
A6TB4-8	BANDS 1-3 LOGIC OUT (+12VDC)
A6TB4-9	BANDS 4-10 LOGIC OUT (+12VDC)
A6TB4-10	BANDS 11-15 LOGIC OUT (+12VDC)
A6TB4-11	BAND STEP UP (↑) INPUT COMMAND (+12VDC)
A6TB4-12	BAND STEP DOWN (↓) INPUT COMMAND (+12VDC)
A6TB4-13	MOTOR ON LOGIC OUTPUT (+12VDC)
A6TB4-14	CAL COMMAND INPUT (+10VDC NOMINAL)
A6TB4-15	CAL COMMAND INPUT (+10VDC) TO IG DRIVER A2A17
A6TB4-16	IG CHARGE VOLTAGE INPUT (+6.5 to +70VDC)
A6TB4-17	+RAW VOLTAGE INPUT TO I.G.
A6TB4-18	–RAW VOLTAGE INPUT TO I.G.
A6TB4-19	IG GND

2. Peak all coils (L2, L4, L7, L10) for a maximum indication on the front panel meter. (NOTE: The coils are adjusted through the alignment holes in the module's bottom cover).
3. Check the 6dB bandwidth of the amplifier circuit. Using a point on the front panel meter as a reference, increase the input frequency until the meter reads 6dB down from the reference – record the frequency at this point. Next decrease the frequency until the meter again reads 6dB down from the reference point – record the frequency at this point. Subtract the two frequency readings, the difference should be 9kHz ± 1kHz (6dB bandwidth of the 1.6MHz IF Amplifier circuit).
4. If the 6dB bandwidth does not meet the specification limits, adjust C7 and repeak coils L2 and L4. Always check the bandpass symmetry after C7 is adjusted to verify that the bandpass waveform is still symmetrical about the 1.6MHz center frequency (e.g. is the frequency division on each side of the center frequency approximately equal, that the meter drops smoothly with no abrupt uses, dips, or double-peaking).
5. If the bandwidth still does not meet specification limits after the above steps have been accomplished, it may be necessary to change the length of coil L6 plus repeak C7, L2, and L4. Coil L6 is located between coils L7 and L10 and is a length of #22 buss wire formed around a 5/16 inch diameter rod. Increase the coil length to decrease bandwidth and decrease the coil length to increase bandwidth.

NOTE: The top and bottom covers of the module must be removed to perform the work on coil L6.

C. Method 2 Alignment Procedure.

1. This method utilizes a sweep oscillator to drive the IF amplifier circuit with the IF output connected to an oscilloscope (refer to the sweep oscillator's manual for operational useage and setups). The center frequency of the sweep oscillator is set for 1.600MHz and the sweep width set for at least double the bandwidth being sweeped (18 to 20kHz).
2. Set the oscilloscope parameters (refer to the oscilloscope's manual for operational useage) to enable a representation of the IF amplifier bandpass waveform to be presented on the CRT display.
3. Peak all coils (L2, L4, L7, L10) for maximum on the CRT, the bandpass waveform should be symmetrical about the center frequency of 1.600MHz.
4. Check the 6dB bandwidth by recording the frequency 6dB down each side of the waveform and subtracting the two readings. The difference is the 6dB bandwidth for the IF amplifier circuit (9kHz ± 1kHz). If the bandwidth does not meet the unit's specification limits, follow the procedure given in Method 1 steps 4 and 5.

D. After the bandwidth has been measured/adjusted utilizing either Method 1 or 2, the IF output (A3J4) should be connected to the LINEAR DETECTOR Module.

E. Apply a 1.600MHz signal at an input of 20dBuv (10uV) to the 1.6MHz IF INPUT connector (A3J1), the front panel meter should read Full Scale (0dB). If not, adjust A3A1-R10 (1.6MHz IF GAIN) for a Full Scale reading.

F. Set the ATTENUATION DISPLAY for +10dB, the meter should read −10dB. Increase the input signal level to 30dBuV (30uV), the meter should read Full Scale. This checks out the 1.6MHz IF attenuator.

5.7.6.3 8.7MHz IF (A3A2) ALIGNMENT

A. Set the CPR-25 front panel controls as per 5.7.6.2A except for the following:

FREQUENCY RANGE . . . . BAND 11
ATTENUATION Setting . . . . +10dB

B. Method 1 Alignment Procedure

1. Using a signal generator, apply an input signal of 8.7000MHz at a level of 0dBuV (1uV) to the 8.7MHz IF INPUT (A3J2). The output connector A3J4 (1.6MHz IF OUTPUT) should be connected via a subminiature coaxial cable to the input connector (A4J1) of the LINEAR DETECTOR Module (A4).
2. Peak all coils/transformers (L2, L4, L11, L12, T1, T2) for maximum on the front panel meter. (NOTE: The coils are adjusted through the alignment holes in the module's bottom cover).

3. Check the 6dB bandwidth of the amplifier circuit. Follow the same procedure as given for the 1.6MHz Alignment Procedure 5.7.6.2B Method 1 step 3. The difference between the two readings should be 120kHz ± 10kHz (6dB bandwidth of the 8.7MHz IF Amplifier circuit).
4. If the 6dB bandwidth does not meet the specification limits, adjust C6 and repeak coils L2 and L4. Also verify that the bandpass waveform is still symmetrical about the 8.7MHz center frequency by utilizing the information given for the 1.6MHz Alignment Procedure 5.7.6.2B Method 1 step 4.
5. If the bandwidth still does not meet specification limits after the above steps have been accomplished, it may be necessary to change the value of L9 (nominal value 3.9uh) and repeak all coils. Increase the value of L9 to increase bandwidth, decrease the value of L9 to decrease the bandwidth. If the waveform becomes unsymmetrical, decrease or increase the value of R23 (nominal value 15K) until the waveform is symmetrical.

C. Method 2 Alignment Procedure

1. This method utilizes the sweep oscillator and oscilloscope in the same manner as the 1.6MHz Alignment Procedure 5.7.6.2C Method 2. The center frequency is set at 8.700MHz, sweep width approximately 240kHz.
2. Peak all coils/transformers (L2, L4, L11, L12, T1, T2), for maximum on the CRT of the oscilloscope. Again the bandpass waveform should be symmetrical about the center frequency of 8.700MHz.
3. The 6dB bandwidth is checked in the same manner as for the 1.6MHz Alignment Procedure 5.7.6.2C Method 2 step 4. 6dB bandwidth should be 120kHz ±10kHz. If the bandwidth does not meet the unit's specification limits, follow the procedure given in 8.7MHz Alignment Procedure 5.7.6.3B Method 1 steps 4 and 5.

D. After the bandwidth has been measured/adjusted utilizing either Method 1 or 2, the IF Output (A3J4) should be connected to the LINEAR DETECTOR Module.

E. Apply an 8.700MHz signal at an input level of 10dBuV (3uV) to the 8.7MHz IF INPUT connector (A3J2), the front panel meter should read Full Scale (0dB). If not, adjust A3A2-R8 (8.7MHz IF GAIN) for a Full Scale reading.

F. Set the ATTENUATION DISPLAY for +20dB, the meter should read -10dB. Increase the input signal level of 20dBuV (10uV), the meter should read Full Scale. This checks out the 8.7MHz IF attenuator.

5.7.7 DISCRIMINATOR CIRCUITRY (A3A3) ADJUSTMENT

NOTE: The Discriminator circuitry alignment is extremely stable. Realignment should be performed only when a signal cannot be satisfactorily acquired and locked with the AFC on as described in Section III.

Equipment used: Signal Generator
Digital Voltmeter

The following procedure covers the adjustment of the DISCRIMINATOR Circuitry (A3A3) which is located within the IF AMPLIFIER/DISCRIMINATOR Module (A3).

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE .... BAND 11

B. Remove the A3 module as per 5.7.6.1. Remove the cables from the DISCRIMINATOR INPUT (A3J3) and FM OUTPUT (A3J5) connectors.

NOTE: The following adjustments should be performed with both covers secured to the module. If the adjustments are performed with either one or both covers removed, the settings will be slewed by the capacitance effect of the covers when installed.

C. Connect a digital voltmeter via a subminiature to clip lead coaxial cable to connector A3J5 (FM OUTPUT). Using a signal generator apply an input signal of 1.600MHz at a level of +120dBuV (1V) to the DISCRIMINATOR INPUT connector (A3J3).

D. The digital voltmeter should read 0.000VDC, if not adjust A3A3-T2 (ZERO ADJUST).

E. Change the signal generator frequency to 1.625MHz, the voltmeter should read approximately +3.0VDC.

F. Decrease the signal generator frequency to 1.575MHz, the voltmeter should read approximately -3.0VDC.

G. The voltages in step E and F should be of the same approximate value but of different polarity. If not or the range is too narrow (2.75VDC), adjust A3A3-T1 (RANGE ADJUST) at the frequency extremes in conjunction with A3A3-T2 at the center frequency.

NOTE: Steps H thru O of the DISCRIMINATOR adjustment procedure is normally performed after adjustment of the Mixer Module (A5) and RF Preselector Assembly (A2) has been completed.

H. This part of the procedure is performed after the module has been reinstalled into the unit and all input/output cables have been reconnected. Set the CPr-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE . . . . BAND 10
FREQUENCY Setting 22MHz
ATTENUATION Setting . . . . +10dB

I. Using a signal generator, apply a 22MHz CW signal at a level of +10dBuV (3uV) to the front panel RF INPUT connector. Peak the signal for maximum on the front panel meter. The meter should read Full Scale (0dB) on the Linear scale, if not adjust the CAL GAIN control for a Full Scale reading.

J. Using the Full Scale reading as a reference point, turn on the AFC switch. The meter should read Full Scale (0dB) ±1.0dB.

K. With the AFC "ON", increase the signal generator frequency until the meter reads 3dB down from the reference point. Turn off the AFC, the meter should drop a minimum of 18dB down from the reference point.

L. In a similar manner with the AFC ON, decrease the signal generator frequency read 3dB down from the reference point. Again turn the AFC OFF, the meter should drop a minimum of 18dB down from the reference point.

M. Repeat steps H thru L for BAND 3 at a CW frequency of 110kHz at a level of -10dBuV (0.3uV).

N. Repeat steps H thru L for BAND 15 at a CW frequency of 750MHz at a level of +20dBuV (10uV).

O. If the reference point change is greater than ±1.0dB, the zero voltage adjustment (step D) may have to be checked.

5.7.8 MIXER MODULE (A5) ADJUSTMENT

Equipment used: Signal Generator

The following procedure covers the adjustment of the Mixer Circuitry (A5A1) located within the MIXER Module (A5).

5.7.8.1 A5 MODULE REMOVAL/PREPARATION

A. The MIXER Module (A5) must be removed from the Submodule Assembly package in order to perform the following procedure.

B. Refer to the general procedure given in 5.6.6, removing only the MIXER MODULE (A5). The Module's fanning strip should remain connected to the A6 terminal block, remove the four subminiature coaxial cables from the input connectors of the Module (A5J1-J4). The remaining two cables are to remain connected to the module (A5J5-J6).

C. Remove the Module's top cover (identified by the alignment holes) by removing the screws which secure it to the module.

D. Place the module on a piece of masonite or similar material laid across the top of the remaining two modules and the edge of the unit.

5.7.8.1.1 FRONT PANEL CONTROL SETTINGS

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE . . . . BAND 3 to start
ATTENUATION Setting . . . . -10dB
CAL GAIN Control . . . . Set to 10dB reserve gain as established in 5.7.5.4 step L.

5.7.8.2 BANDS 1-3, 7 ADJUSTMENT/VERIFICATION

5.7.8.2.1 BANDS 1-3

A. Set the FREQUENCY RANGE for BAND 3. Using a signal generator, apply a 175kHz CW signal at a level of 35dBuV to connector A5J1 (175kHz INPUT).

B. Peak the signal generator for maximum on the front panel meter. Tune carefully since the bandwidth for the BANDS 1-3 175kHz MIXER Channel is fixed at 220Hz by means of a crystal filter. The meter should read Full Scale (0dB) ±1.0dB on the Linear scale.

C. If the reading is greater than ±2.0dB, it may indicate problems within the crystal filter circuitry. Contact the factory or the nearest ELECTRO-METRICS representative.

5.7.8.2.2 BAND 7

A. Set the FREQUENCY RANGE for BAND 7. With the signal generator remaining at 175kHz, increase the output level of 55dBuV.

B. Peak the signal generator for maximum on the front panel meter. The meter should read Full Scale (0dB) on the Linear scale. If not, adjust A5A1-R32 (BAND 7 ADJUST) for a Full Scale reading.

5.7.8.3 BANDS 4-6, 8-10 ADJUSTMENT

A. Set the FREQUENCY RANGE for BAND 8. Using a signal generator, apply a 1.600MHz CW signal at a level of 55dBuV to connector A5J4 (1.6MHz INPUT).

B. Peak the signal generator for maximum on the front panel meter. The meter should read Full Scale (0dB) on the Linear scale. If not, adjust A5A1-R54 (BANDS 4-6, 8-10 ADJUST) for a Full Scale reading.

5.7.8.4 BANDS 11-12 (8.7MHz) ADJUSTMENT

A. Set the FREQUENCY RANGE FOR BAND 11. Using the signal generator, apply an 8.700MHz CW signal at a level of 35dBuV to connector A5J3 (RF/IF INPUT BANDS 11-15).

B. Peak the signal generator for maximum on the front panel meter. The meter should read Full Scale (0dB) on the Linear scale. If not, adjust A5A1-R12 (BANDS 11-15 ADJUST) for a Full Scale reading.

C. Verify that transformer A5A1-T2 is adjusted for a peak reading on the front panel meter.

5.7.8.5 BAND 13 (38.7MHz) ADJUSTMENT

A. Set the FREQUENCY RANGE for BAND 13. Change the signal generator frequency to 38.7MHz, output level remains at 35dBuV.

B. Peak the signal generator for maximum on the front panel meter. The meter should read Full Scale (0dB) on the Linear scale. Verify that A5A1-C5 (30MHz CRYSTAL CKT ADJUST) is peaked for maximum on the meter.

5.7.8.6 BAND 14 (68.7MHz) ADJUSTMENT

A. Set the FREQUENCY RANGE for BAND 14. Change the signal generator frequency to 68.7MHz, output level remains at 35dBuV.

B. Peak the signal generator for maximum, front panel meter should read Full Scale (0dB) on the Linear scale. Verify that A5A1-C22 (60MHz CRYSTAL CKT ADJUST) is peaked for maximum on the meter.

5.7.8.7 BAND 15 (98.7MHz) ADJUSTMENT

A. Set the FREQUENCY RANGE for BAND 15. Change the signal generator frequency to 98.7MHz, output level remains at 35dBuV.

B. Peak the signal generator for maximum, front panel meter should read Full Scale (0dB) on the Linear scale. Verify that A5A1-C34 (90MHz CRYSTAL CKT ADJUST) is peaked for maximum on the meter.

NOTE: For Bands 11-15, it may be necessary to compromise between all 5 upper band levels utilizing A5A1-R12 (BANDS 11-15 ADJUST) in order to meet the unit specification limit of Full Scale (0dB) ±2.0dB.

5.7.9 TUNING VOLTAGE – SWEEP CIRCUITRY ADJUSTMENTS

Equipment used: Digital Voltmeter.
22 pin double-sided extension board (ECB-25C). (2 extension boards should be utilized to facilitate performance of the following procedure).

The following procedure covers the adjustment of the Tuning Voltage – Sweep circuitry including the SWEEP Board (A1A6), SWEEP CONTROL Board (A1A5), and TUNING REGULATOR Board (A2A16A2). The SWEEP CONTROL (A1A5) and SWEEP (A1A6) boards are located in a card guide bracket mounted behind the front panel meter (SWEEP CONTROL board is nearest the meter). The TUNING REGULATOR board (A2A16A2) is located within a card guide bracket inside the RF PRESELECTOR (A2) Assembly.

5.7.9.1 TUNING VOLTAGE ADJUSTMENT/ VERIFICATION

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

COARSE TUNING Control . . . . .FULL CW to start.
FREQUENCY RANGE . . . . BAND 6

> NOTE: In this and the following procedures, except when indicated otherwise, all DC voltage measurements are taken with reference to ground.

B. Remove the SWEEP CONTROL (A1A5) board from its connector behind the meter. Mount the board on the 22 pin extender boards (NOTE: Two (2) extensions boards, one inserted into the other are utilized to facilitate performance of the procedure) and reinsert into the connector.

C. Connect the digital voltmeter to A1A5-A and adjust A1A5-R7 (TUNING VOLTAGE SUPPLY) for a reading of +1.50VDC (This is an initial adjustment utilizing A1A5-R7, a further adjustment of A1A5-R7 will occur later in the procedure).

D. Connect the digital voltmeter to A1A5-D, the meter should read approximately +6.0VDC for the COARSE TUNING Control set FULL CW.

E. Set the front panel COARSE TUNING Control to its FULL CCW position. The digital voltmeter should read 0.000VDC, if not adjust A1A5-R34 (MANUAL TUNE ZERO).

F. Connect the digital voltmeter to A2A5-M and set the front panel COARSE TUNING Control to its full CW position. The digital voltmeter should read approximately +1.50VDC. Set the COARSE TUNING Control to its full CCW position, the voltmeter should read 0.000VDC. If not, repeat steps C thru E.

G. Connect the digital voltmeter to the TUNING VOLTAGE (TV) test point located on the RF PRESELECTOR (A2) Stator bracket. (see Fig. 6.1A) With the COARSE TUNING Control set FULL CCW, adjust (on the TUNING REGULATOR board A2A16A2) A2A16A2-R36 (H.V. ZERO ADJUST) for a slightly negative reading (-0.002 to -0.005VDC) on the voltmeter.

H. Set the COARSE TUNING Control to its full CW position. The digital voltmeter should read +98.5VDC, if not readjust A2A5-R7 (TUNING VOLTAGE SUPPLY) on the SWEEP CONTROL board (A1A5).

I. Due to interaction between the above adjustments, repeat steps G and H until no further readjustments are necessary.

J. Connect the digital voltmeter to A1A5-X (X OUTPUT TO PLOTTER). Verify that as the COARSE TUNING Control is varied from FULL CCW to FULL CW, the voltage output reading varies from 0.00VDC to +1.50VDC.

5.7.9.2 SWEEP VOLTAGE ADJUSTMENT/ VERIFICATION

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

AUTO SWEEP Switch . . . . OFF
SWEEP TIME Switch . . . . 10 second position
SWEEP MULTIPLIER Control . . . . . . X1 position
SPECTRUM/DISPERSION Switch . . . SPECTRUM

B. Remove the SWEEP CONTROL board (A1A5) from the 2 extender boards and re-insert into its connector. Remove and mount the SWEEP board (A1A6) on the extender boards and re-insert into its connector.

C. Connect the digital voltmeter to A1A6-C. With the controls set as per 5.7.9.2A, the voltmeter should read approximately +12.0VDC. This voltage must be present before proceeding with the following procedure. (If not, contact the factory or the nearest ELECTRO-METRICS representative for assistance.)

D. Connect the digital voltmeter to A1A6-S and verify the following:

1. With the front panel TUNING CONTROL Mode switch in the MANUAL position, the voltmeter should read -12.0VDC.
2. With the TUNING CONTROL Mode switch in the SWEEP position, the voltmeter should read 0.0VDC.
3. Under the conditions of 2, when the SWEEP START switch is pushed, the voltmeter should read +12.0VDC.

E. Temporarily connect A1A6-C to ground. Using a digital voltmeter, measure on A1A6U2-6 and adjust A1A6-R10 (ZERO) for a reading of 0.000VDC. Remove the ground after the adjustment is completed.

F. Connect the digital voltmeter to the TUNING VOLTAGE Test point on the Stator bracket of the RF Preselector (A2) Assembly. Push the front panel SWEEP START switch (TUNING CONTROL Mode switch set to the SWEEP position) and monitor the TUNING VOLTAGE, which starts around 0VDC and sweeps up to approximately 100VDC. A1A6-R29 SWEEP AMPLITUDE SET should be adjusted so that sweep retrace occurs between 99 and 100VDC. Use the SWEEP MULTIPLIER control to slow down the sweep at the high end of the sweep cycle to allow an accurate voltage measurement to be made.

5.7.9.2.1 X-Y RECORDER VERIFICATION

NOTE: This section of the procedure verifies X-Y recorder operation. No alignments or adjustments are performed. If any difficulties are encountered, contact the factory or the nearest ELECTRO-METRICS represenative.

A. Set the CPR-25 front panel controls as per 5.7.9.2A except for the following:

FREQUENCY RANGE .... BAND 6

B. Connect an X-Y recorder to the PLOTTER CONNECTOR (A7J6) of the unit. Align the X-Y recorder as per Section 3.8.3.2 (CPR-25/X-Y Recorder Calibration Procedure) and the recorder's instruction manual.

C. Check the 10 and 100 second positions of the SWEEP TIME switch, including the X1 and X10 positions of the SWEEP MULTIPLIER Control. The sweep time specifications are as follows:

Sweep Time		**Specifications**
10 Seconds		10 Seconds ± 2 Seconds
100 Seconds	(10x10) (100x1)	100 Seconds ± 20 Seconds
1000 Seconds	(100x10)	1000 Seconds ± 200 Seconds

D. In addition to the sweep time, verify the following during the course of performing step C:

NOTE: Utilize the 10 second position of the SWEEP TIME switch for these verifications.

1. Apply an 800kHz CW signal at an input level of +20dBuV (ATTENUATION setting = +20dB) to the CPR-25 RF INPUT. Verify that the Y response to the signal is at the approximate center and top of the chart plot.
2. When the sweep is initiated, that the pen drops before the low end frequency point of the band and lifts after the high end frequency point of the band.
3. AUTO-SWEEP switch on, the pen sweeps at its normal speed until a signal is encountered. Verify that the sweep speed slows down and hesitates at the peak of the signal. After signal peak is passed, normal sweep speed is resumed.
4. PEN #2 – verify that in all three positions of the PEN #2 switch (PEAK, AVERAGE, RMS) for a CW signal, that both pens match to within ~1.0dB. If not, recheck the PEN #2 DRIVER board (A7A1A5) adjustment procedure – Section 5.7.4.2

5.7.9.2.2 EXTERNAL OSCILLOSCOPE/CPR-25 OPERATION VERIFICATION

NOTE: Only one adjustment is performed during this procedure. If any difficulties are encountered, contact the factory or the nearest ELECTRO-METRICS Representative.

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE .... BAND 8
FREQUENCY Setting 5.5MHz
SWEEP TIME Switch .... 0.1 second
SWEEP MULTIPLIER Control XI
SPECTRUM/DISPERSION Switch . . . SPECTRUM
AUTO SWEEP Switch .... OFF
ATTENUATION Setting .... +40dB

B. Connect an oscilloscope to the CPR-25 utilizing the three oscilloscope outputs on the rear of the unit (A7J3 VERTICAL OUTPUT, A7J4 HORIZONTAL OUTPUT, A7J5 BLANKING OUTPUT).

NOTE: Refer to the oscilloscope operating manual for operation with an external horizontal input. All inputs should be DC coupled.

C. Using a signal generator, apply a 5.5MHz CW signal at a level of +40dBuV (100uV) to the front panel RF INPUT connector. Peak the signal for maximum on the front panel meter and adjust for a Full Scale (0dB) reading on the Linear scale using the CAL GAIN Control.

D. Set the DETECTOR FUNCTION switch to the SLIDEBACK position and the THRESHOLD Control FULL CCW. Set the TUNING CONTROL Mode switch to the SWEEP position, a display should appear on the CRT of the oscilloscope equivalent to the CPR-25 band segment being scanned.

E. Verify the following oscilloscope/CPR-25 operation:

   1. MARKER pip is present on the CRT and follows the COARSE TUNING Control action (e.g. TUNING Control turned CW-MARKER moves left to right, TUNING Control turned CCW-MARKER moves right to left).

   2. As the THRESHOLD Control is turned CW, the trace level will move up the CRT. (NOTE: Return THRESHOLD Control to the FULL CCW position when done).

   3. Switch to a slower sweep rate (1.0 second) and rate whether blanking occurs during sweep retrace. If not, check on the SWEEP board A1A6-X with an oscilloscope.

   NOTE: The blanking pulse may be either a positive or negative going pulse depending on the type of oscilloscope utilized. The pulse should correspond to the requirements of the oscilloscope being used.

   4. Center the MARKER at the center of the input signal response on the CRT. Set the SPECTRUM/DISPERSION switch to the DISPERSION position and the DISPERSION Control to the MAX (100%) position. The input signal response should be positioned in the center of the CRT. If not, adjust A1A5-R2 (SWEEP OFFSET) (Located on the SWEEP CONTROL board A1A5) to center the response.

   5. Verify that the DISPERSION Control widen and narrows the signal presentation as follows:

      MAX (100%): Entire signal spectrum visible on CRT.

      MIN (1%): Only 1% of signal spectrum visible on CRT.

5.7.10 RF PRESELECTOR (A2) ASSEMBLY ADJUSTMENT

Equipment used: Signal Generator
Digital Voltmeter
Spectrum Analyzer
Frequency Counter
(Optional)

The following procedure covers the adjustment of the RF Preselector Assembly (A2) and verification of the FREQUENCY DISPLAY Module (A1A3).

5.7.10.1 FREQUENCY DISPLAY MODULE (A1A3) VERIFICATION

The FREQUENCY DISPLAY Module (A1A3) is located on the front panel of the CPR-25 and is an integral part of the RF Preselector circuitry. It utilizes the band code logic and the LO output of the Preselector to indicate the tuned frequency of the receiver. The following procedure will verify whether the module is operating properly. If the module is determined to be defective, it is recommended that it be returned to the factory for repair or replacement due to the complex nature of the internal circuitry.

A. Disconnect the subminiature coaxial cable from the LO INPUT connector A1A3-J1 on the DISPLAY Module.

B. Verify the operation of the FREQUENCY DISPLAY Module by utilizing the information in Table 5-6 (FREQUENCY DISPLAY PRESET/LO INPUT DATA) in the following manner:

   1. With no LO input, verify that the correct PRESET number is present for each band segment (1-15).

   2. Apply a LO input, using an external signal generator, at the frequency and input level indicated for each band segment. Verify that the correct frequency is indicated on the display.

5.7.10.2 LOCAL OSCILLATOR LEVEL

A. Select BAND SEGMENT 1 (10kHz to 35kHz) and connect a clip lead to BNC cable from the LO OUTPUT terminal (A2A16A1-E28) to an oscilloscope.

B. The oscilloscope should read 400mV P-P, if not adjust A2A16A1-R52 (LO LEVEL ADJUST).

5.7.10.3 VARACTOR CHECKS

TABLE 5-7

FREQUENCY RANGE

Band Segment	Frequency Range		Frequency Range With 2% Overlap
	Low	High	
1	10.0kHz (0.01000MHz)	35.0kHz (0.0350MHz)	9.8kHz – 35.7kHz
2	35.0kHz (0.03500MHz)	75.0kHz (0.07500MHz)	34.30kHz – 76.50kHz
3	70.0kHz (0.07000MHz)	150.0kHz (0.1500MHz)	68.60kHz – 153.00kHz
4	120.0kHz (00.1200MHz)	260.0kHz (00.2600MHz)	117.6kHz – 265.2kHz
5	250.0kHz (00.2500MHz)	500.0kHz (00.5000MHz)	245.0kHz – 510.0kHz
6	500.0kHz (00.5000MHz)	1100kHz (01.1000MHz)	490.0kHz –1122kHz
7	1.10MHz (01.1000MHz)	2.40MHz (02.4000MHz)	1.078MHz – 2.448MHz
8	2.40MHz (02.4000MHz)	5.50MHz (05.5000MHz)	2.350MHz – 5.610MHz
9	5.50MHz (05.5000MHz)	12.50MHz (12.5000MHz)	5.390MHz – 12.75MHz
10	12.5MHz (012.5000MHz)	30.0MHz (030.000MHz)	12.25MHz – 30.6MHz
11	25.0MHz (025.000MHz)	50.0MHz (050.000MHz)	24.50MHz – 51.00MHz
12	50.0MHz (050.000MHz)	100.0MHz (100.000MHz)	49.0MHz – 102.0MHz
13	100.0MHz (0100.00MHz)	200.0MHz (0200.00MHz)	98.0MHz – 214.2MHz
14	200.0MHz (0200.00MHz)	500.0MHz (0500.00MHz)	196.0MHz – 510.0MHz
15	500.0MHz (0500.00MHz)	1000.0MHz (1000.00MHz)	490MHz – 1020MHz

NOTE: The frequency given in parentheses is the actual FREQUENCY DISPLAY indication.

F. Transformer A2A16A1-T2 (175kHz OUTPUT), located near the bottom of the Stator board, should be peaked for maximum in the following manner:
   1. Apply a 175kHz CW signal at a high level (approximately 1VRMS) to the front panel RF INPUT connector. Set the frequency RANGE to BAND 1.
   2. An indication will appear on the front panel meter, peak A2A16A1-T2 for maximum.

G. After the above adjustments have been completed, the overall gain adjustment for each band segment should be adjusted for a Full Scale (0dB) reading on the Linear scale. Use a frequency at the center of the selected band segment.

H. In addition due to interactions between most of the transformer, choke, trimmer, and padder adjustments, it will be necessary to repeat the low, middle, and high adjustments until no further readjustments are necessary. It may also be necessary to readjust some of the above adjustments in order to flatten out the overall band response within a specification of ±2.0dB.

5.7.10.4.1.2 RF BAND SEGMENTS 4-9

Final IF Frequency: 1.6MHz except for BAND SEGMENT 7 whose final IF Frequency is 175kHz.

Frequency Range (4-9): See Table 5-7

A. Set the CPR-25 front panel controls as per 5.7.10.4.1.1A

NOTE: The ATTENUATION setting should read ±10dB for BAND SEGMENTS 4-9.

B. The CW input signal level for BAND Segments 4-9 is +10dBuV (3uV).

TABLE 5-8

BAND SEGMENTS 1-9 ADJUSTMENTS

Band Segment	Frequency Adjustments			RF Adjustments		
	Low	Mid	High	Low	High	Overall Gain
1	A2A1-C10 10kHz	A2A1-T4 22kHz	A2A1-C6 35kHz	A2A1-T1 A2A1-L2 A2A1-L3	A2A1-C1 A2A1-C2 A2A1-C5	A2A1-R3
2	A2A2-C8 35kHz	A2A2-T4 55kHz	A2A2-C4 75kHz	A2A2-T1 A2A2-T2 A2A2-L3	A2A2-C1 A2A2-C2 A2A2-C3	A2A2-R1
3	A2A3-C8 70kHz	A2A3-T4 110kHz	A2A3-C4 150kHz	A2A3-T1 A2A3-T2 A2A3-L3	A2A3-C1 A2A3-C2 A2A3-C3	A2A3-R1
4	A2A4-C9 120kHz	A2A4-T4 210kHz	A2A4-C5 260kHz	A2A4-T1 A2A4-T2 A2A4-L3	A2A4-C1 A2A4-C2 A2A4-C3	A2A4-R2
5	A2A5-T4 250kHz	–	A2A5-C7 500kHz	A2A5-T1 A2A5-L2 A2A5-L3	A2A5-C1 A2A5-C3 A2A5-C5	A2A5-R2
6	A2A6-C5 500kHz	A2A6-T4 800kHz	A2A6-C6 1100kHz	A2A6-T1 A2A6-L2 A2A6-L3	A2A6-C1 A2A6-C2 A2A6-C4	A2A6-R2
7	A2A7-T4 1.10MHz	–	A2A7-C6 2.40MHz	A2A7-T1 A2A7-L2 A2A7-L3	A2A7-C1 A2A7-C2 A2A7-C4	A2A7-R2
8	A2A8-T4 2.40MHz	–	A2A8-C6 5.50MHz	A2A8-T1 A2A8-L2 A2A8-L3	– A2A8-C2 A2A8-C4	A2A8-R2
9	A2A9-T4 5.50MHz	–	A2A9-C6 12.5MHz	A2A9-T1 A2A9-L2	A2A9-C1 A2A9-C2	A2A9-R2

C. The basic adjustment procedure for BAND SEGMENTS 4-9 is similar to the procedure for BAND SEGMENTS 1-3. The CW signal at the input level given in step B is applied to the RF INPUT connector starting with BAND SEGMENT 4.

D. Again, refer to Table 5-8 and adjust the transformers, choker, trimmers, and padders for a maximum indication on the front panel meter at the frequencies indicated for the selected band segment.

E. Transformer A2A16A1-T3 (1.6MHz OUTPUT), located at the bottom of the Stator board, should be peaked for maximum in the following manner:
   1. Apply a 1.6MHz CW signal at a high level (approximately 1VRMS) to the front panel RF INPUT connector. Set the FREQUENCY RANGE to BAND 4.
   2. An indication will appear on the front panel meter, peak A2A16A1-T3 for maximum.

F. After the above adjustments have been completed, the overall gain adjustment for each band segment should be adjusted for a Full Scale (0dB) reading on the Linear scale. Again, use a frequency at the center of the selected band segment.

G. Again, due to interactions between the various adjustments it will be necessary to repeat the above adjustments until no further adjustments are required. It may also be necessary to perform some additional readjustments to keep band flatness within ±2.0dB.

5.7.10.4.1.2.1 MIXER NULL

A. Set the CPR-25 front panel controls as per 5.7.10.4.1.2A except for the following:

FREQUENCY RANGE BAND6
FREQUENCY Setting 800kHz

B. Apply an 800kHz CW signal at a level of +10dBuV to the front panel RF INPUT connector. Peak the signal for maximum on the front panel meter.

C. Connect, via a subminiature to BNC coaxial cable, a spectrum analyzer to connector A2J4 (1.6MHz IF OUTPUT) of the Preselector.

D. Select a dispersion range on the spectrum analyzer which will allow the 1.6MHz IF Frequency, the 800kHz input signal, and the 2.4MHz LO Frequency to be displayed on the CRT.

E. Adjust A2A16A1-R35 (SIGNAL NULL) to null out the CW signal component (800kHz).

F. Adjust A2A16A1-R38 (LO NULL) to null out the LO component (2.4MHz).

5.7.10.4.1.3 RF BAND SEGMENT 10

Final IF Frequency: 1.6MHz

Frequency Range: See Table 5-7

BAND SEGMENT 10 has all its active circuitry, except for the LO oscillator, contained within the band assembly. The LO oscillator circuitry operates in the same manner as for BAND SEGMENTS 1-9.

A. Set the CPR-25 front panel controls as per 5.7.10.4.1.2A.

B. The CW signal input level remains at +10dBuV into the front panel RF INPUT connector.

C. BAND SEGMENT 10 is basically aligned in the same manner as BAND SEGMENTS 1-9. The adjustments are as follows:

Frequency Adjustments:
LOW END (12.5MHz) = A2A10-T3
HIGH END (30.0MHz) = A2A10-C24

RF Adjustments:

LOW END (12.5MHz)	**MID** (21.0MHz)	**HIGH END** (30.0MHz)
A2A10-T1	—	A2A10-C1
A2A10-R13	—	A2A10-T2
A2A10-R19	—	A2A10-L1
A2A10-R24	A2A10-L2	A2A10-C17

D. The gain of the band segment is adjusted by varying fixed resistors A2A10-R1, R6, or R14 to set the gain at Full Scale (0dB) ±2.0dB on the Linear scale.

E. Again due to interaction between adjustments, it is necessary to repeat the above adjustments until no further readjustments are required.

The gain requirement is Full Scale (0dB) ±2.0dB.

The band flatness requirement is ±2.0dB.

5.7.10.4.1.4 RF BAND SEGMENTS 11-15

BAND SEGMENTS 11-15 are completely self-contained modules with all RF and LO circuitry located within the band segment. The proper operation of BAND SEGMENTS 11-15 is dependent upon component arrangement and short lead length. Due to the critical nature of these circuits, field/customer repair is not recommended. Schematic diagrams are included in Section VI as an aid to understanding CPR-25 operation and for emergency repairs only.

5.7.10.5 CAL LEVEL ADJUSTMENTS

This part of the procedure covers the CAL LEVEL adjustments for the internal calibration standard. The CAL LEVEL adjustments are contained on the IF/MIXER CONTROL board (A6A2) which is located in a card guide bracket mounted to the A6 Power Supply Assembly.

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

FREQUENCY RANGE	BAND3
FREQUENCY Setting	110kHz
ATTENUATION Setting	-20dB

B. Apply a 110kHz CW signal at a level of -20dBuV into the front panel RF INPUT connector. Peak the signal for maximum on the front panel meter.

C. The meter should read Full Scale (0dB) ±2.0dB on the Linear scale. If not, use the CAL GAIN control to adjust the reading for Full Scale.

NOTE: If the error is greater than the specified ±2.0dB, recheck the preceding modules and subassemblies utilizing their respective procedures to isolate the section causing the error.

D. Switch the DETECTOR OUTPUT switch to the LOG position, the front panel meter should now read 0dB on the Log scale. Push the CAL button, the meter should read 0dB in the Log scale, if not adjust A6A2-R40 (BANDS 1-3 CAL ADJUST).

E. Check the signal versus CAL levels at the midrange points of BAND SEGMENTS 1 & 2 (signal input level remains at -20dBuV). Verify that the level difference is a maximum of ±2.0dB. If not adjust A6A2-R40 for the best overall accuracy for BAND SEGMENTS 1-3.

F. Check the front panel controls as follows:

FREQUENCY RANGE	BAND 4
FREQUENCY Setting	200kHz
DETECTOR OUTPUT	LINEAR

NOTE: The ATTENUATION DISPLAY will indicate 0dB in BAND SEGMENTS 4-10.

G. Apply a 200kHz CW signal at a level of 0dBuV into the RF INPUT. Peak the signal for maximum on the front panel meter. The meter should read Full Scale (0dB) ±2.0dB on the Linear scale. (If not see Step C).

H. Switch the DETECTOR OUTPUT switch to the LOG position, the front panel meter should now read 0dB on the Log scale. Push the CAL button; the meter should read 0dB on the Log scale, if not adjust A6A2-R31 (BANDS 4-7 CAL ADJUST).

I. Check the signal versus CAL levels at the midrange points of BAND SEGMENTS 5-7 (same input signal levels). Verify that the level difference is a maximum of ±2.0dB. If not, adjust A6A2-R31 for the best overall accuracy for BAND SEGMENTS 4-7.

J. Repeat the procedure given in F thru I for BAND SEGMENTS 8 & 9, except for the following:
   1. Set the FREQUENCY RANGE to BAND 8 at a frequency setting of 4.0MHz.
   2. Adjust A6A2-R32 (BAND 8-9 CAL ADJUST) to match the signal versus CAL levels.

K. Again repeat the above procedure F thru I for BAND SEGMENT 10, except for the following:
   1. Set the FREQUENCY RANGE to BAND 10 at a frequency setting of 22.0MHz.
   2. Adjust A6A2-R34 (BAND 10 CAL ADJUST) to match the signal versus CAL levels.

L. Change the front panel controls as follows:

FREQUENCY RANGE	BAND 11
FREQUENCY Setting	37.5MHz
DETECTOR OUTPUT	LINEAR
ATTENUATION Setting	+30dB

M. Apply a 37.5MHz CW signal at a level of +30dBuV into the front panel RF INPUT connector. Peak the signal for maximum on the front panel meter. The meter should read Full Scale (0dB) ±2.0dB on the Linear scale. (If not see C.)

N. Switch the DETECTOR OUTPUT switch to the LOG position, the front panel meter should read 0dB on the Log scale. Push the CAL button; the meter should read 0dB on the Log scale, if not adjust A6A2-R36 (BANDS 11-12 CAL ADJUST).

O. Check the signal versus CAL levels at the midrange point of BAND SEGMENT 12 (75MHz @ +30dBuV). Verify that the level difference is a maximum of ±2.0dB. If not, adjust A6A2-R36 for the best overall accuracy for BAND SEGMENTS 11 & 12.

P. Repeat Step N for BAND SEGMENTS 13-15 except for the following:

1. Adjust the following to match the signal versus CAL levels:

BAND 13	A6A2-R37 (BAND 13 CAL ADJUST)
BAND 14	A6A2-R38 (BAND 14 CAL ADJUST)
BAND 15	A6A2-R39 (BAND 15 CAL ADJUST)

2. Midrange frequencies:
   BAND 13 = 150MHz
   BAND 14 = 350MHz
   BAND 15 = 750MHz

5.7.11 OVERLOAD LIMIT ADJUSTMENT

The following procedure covers the overload limit alignment utilizing the overload circuitry on the PEAK DETECTOR board (A7A1A2).

A. Set the CPR-25 front panel controls as per 5.7.2 except for the following:

DETECTOR OUTPUT Switch	LOG
DETECTOR FUNCTION Switch	PEAK
FREQUENCY RANGE	BAND 15
ATTENUATION Setting	0dB
CAL GAIN Control	Set at 10dB reserved gain as established in 5.7.5.4 step 1.

B. Apply an impulsive signal to the RF INPUT connector of the CPR-25 using an external CIG-25 Impulse Genrator (or equivalent).

C. Starting at a low level, increase the output of the Impulse Generator until the front panel meter Log scale increases only 7-8dB for a 10dB increase in signal level.

D. Adjust A7A1A2-R28 (OVERLOAD LEVEL) on the PEAK DETECTOR board (A7A1A2) to produce a blinking OL indication on the front panel ATTENUATION DISPLAY for this point.

5.8 STORAGE

To protect the equipment from damage, loss, and dust, the receiver and its accessories should be stored in their respective transit cases. If the optional battery A9 is installed, storage should not exceed 3 months unless the battery is recharged at 3-month intervals by connecting the receiver to an AC source for a 24-hour period. For longer periods of unattended storage, the battery should be removed as per 5.6.4.1. Prior to and following long-term storage, the performance checkout procedure of Section IV should be performed and any indicated adjustments or repairs made.

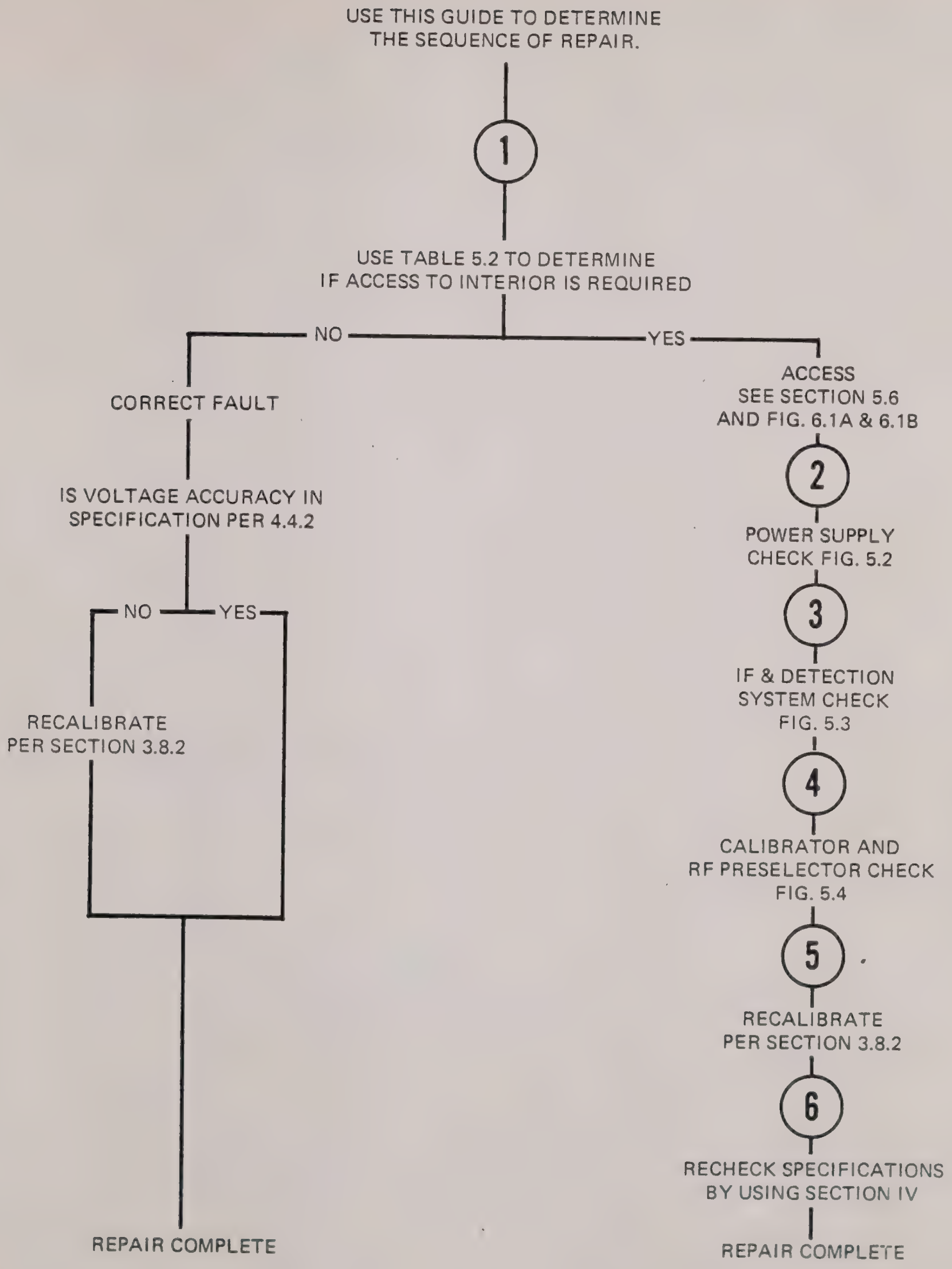
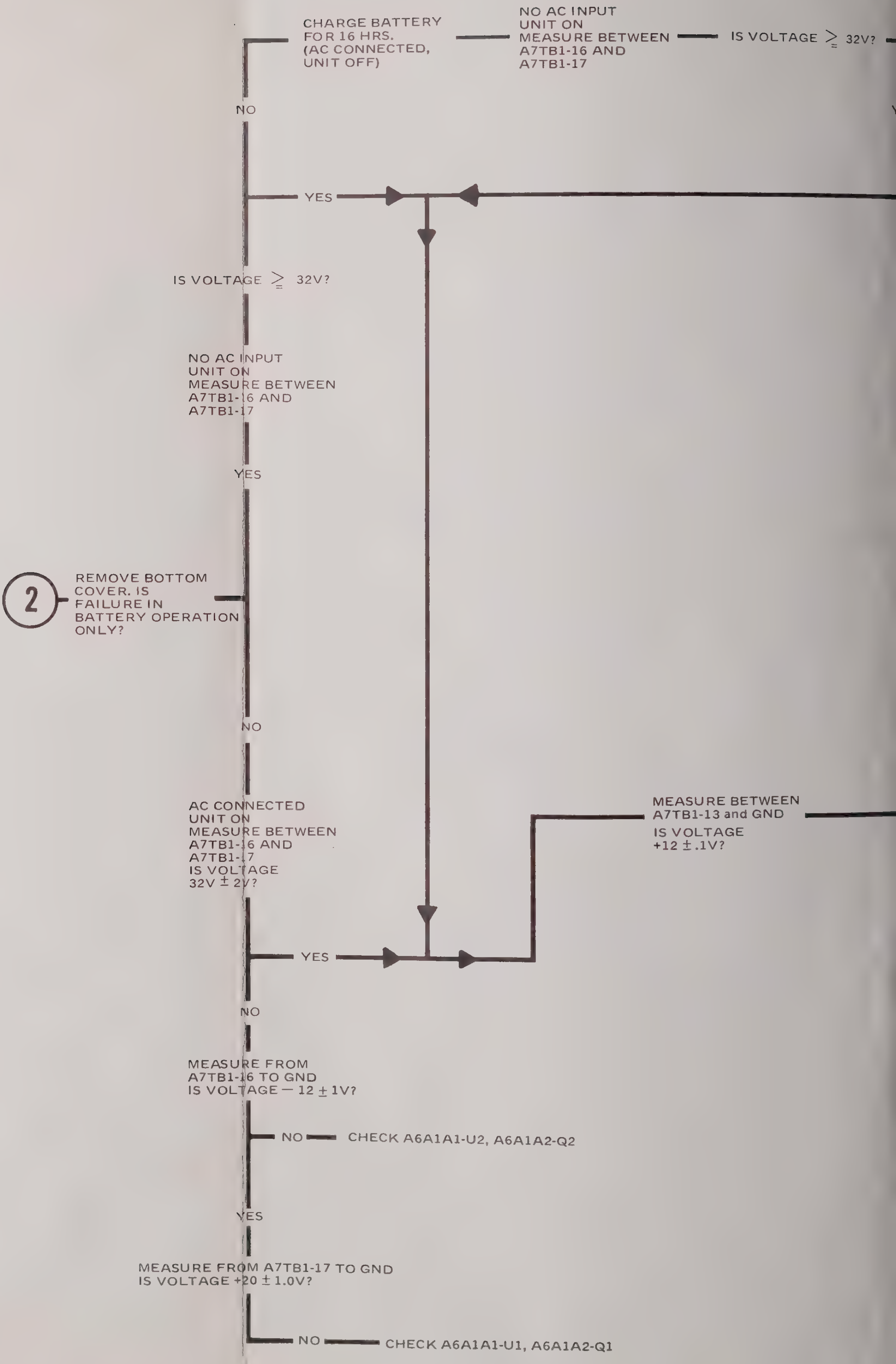

USE THIS GUIDE TO DETERMINE THE SEQUENCE OF REPAIR.
1
USE TABLE 5.2 TO DETERMINE IF ACCESS TO INTERIOR IS REQUIRED
NO
YES
CORRECT FAULT
IS VOLTAGE ACCURACY IN SPECIFICATION PER 4.4.2
NO
YES
RECALIBRATE PER SECTION 3.8.2
REPAIR COMPLETE
ACCESS SEE SECTION 5.6 AND FIG. 6.1A & 6.1B
2
POWER SUPPLY CHECK FIG. 5.2
3
IF & DETECTION SYSTEM CHECK FIG. 5.3
4
CALIBRATOR AND RF PRESELECTOR CHECK FIG. 5.4
5
RECALIBRATE PER SECTION 3.8.2
6
RECHECK SPECIFICATIONS BY USING SECTION IV
REPAIR COMPLETE

Figure 5.1

Troubleshooting/Repair Sequence Guide


CHARGE BATTERY FOR 16 HRS. (AC CONNECTED, UNIT OFF)
NO AC INPUT UNIT ON MEASURE BETWEEN A7TB1-16 AND A7TB1-17
IS VOLTAGE ≥ 32V?
NO
YES
IS VOLTAGE ≥ 32V?
NO AC INPUT UNIT ON MEASURE BETWEEN A7TB1-16 AND A7TB1-17
YES
2
REMOVE BOTTOM COVER. IS FAILURE IN BATTERY OPERATION ONLY?
NO
AC CONNECTED UNIT ON MEASURE BETWEEN A7TB1-16 AND A7TB1-17 IS VOLTAGE 32V ± 2V?
MEASURE BETWEEN A7TB1-13 and GND IS VOLTAGE +12 ± .1V?
YES
NO
MEASURE FROM A7TB1-16 TO GND IS VOLTAGE − 12 ± 1V?
NO
CHECK A6A1A1-U2, A6A1A2-Q2
YES
MEASURE FROM A7TB1-17 TO GND IS VOLTAGE +20 ± 1.0V?
NO
CHECK A6A1A1-U1, A6A1A2-Q1

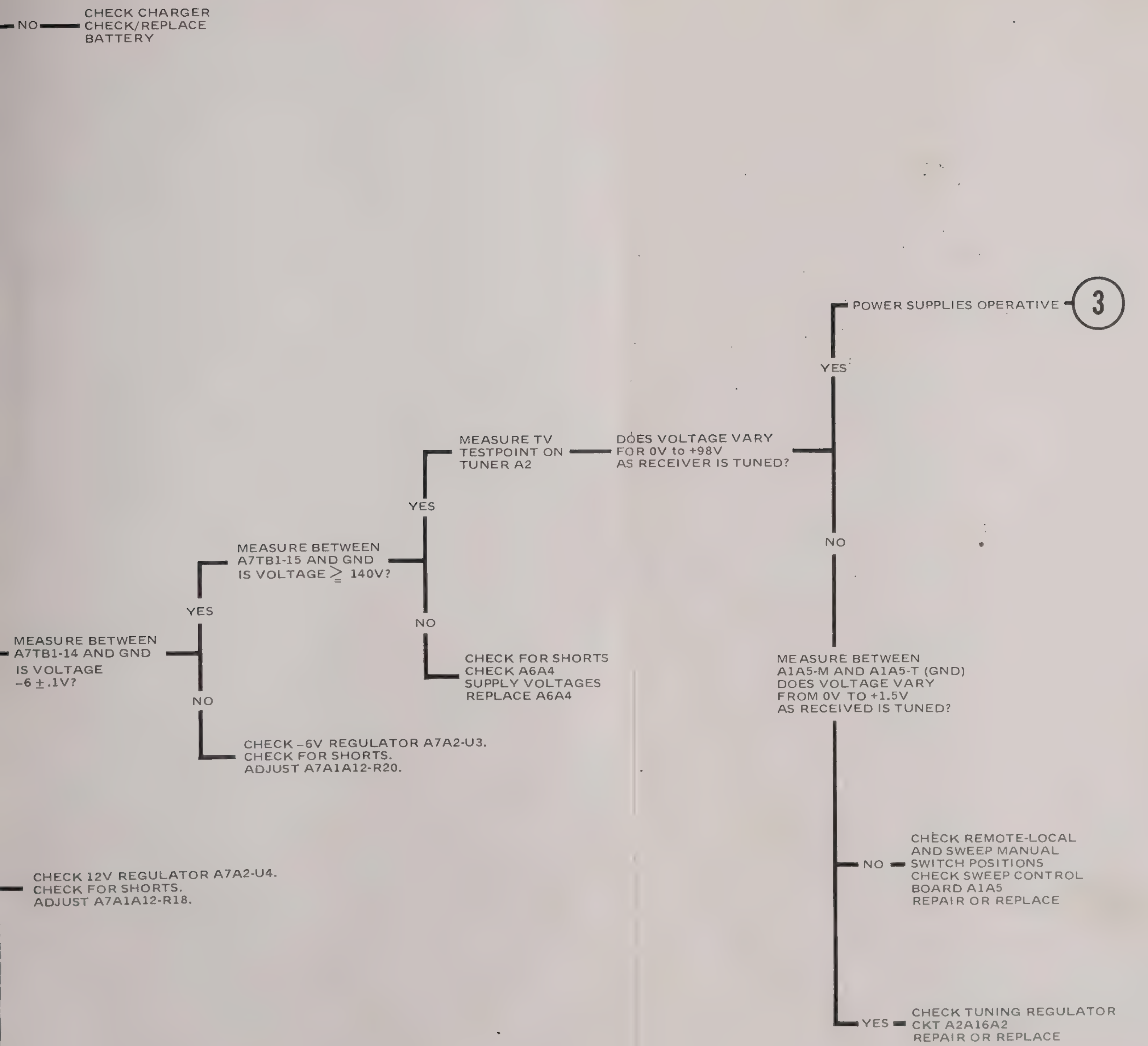
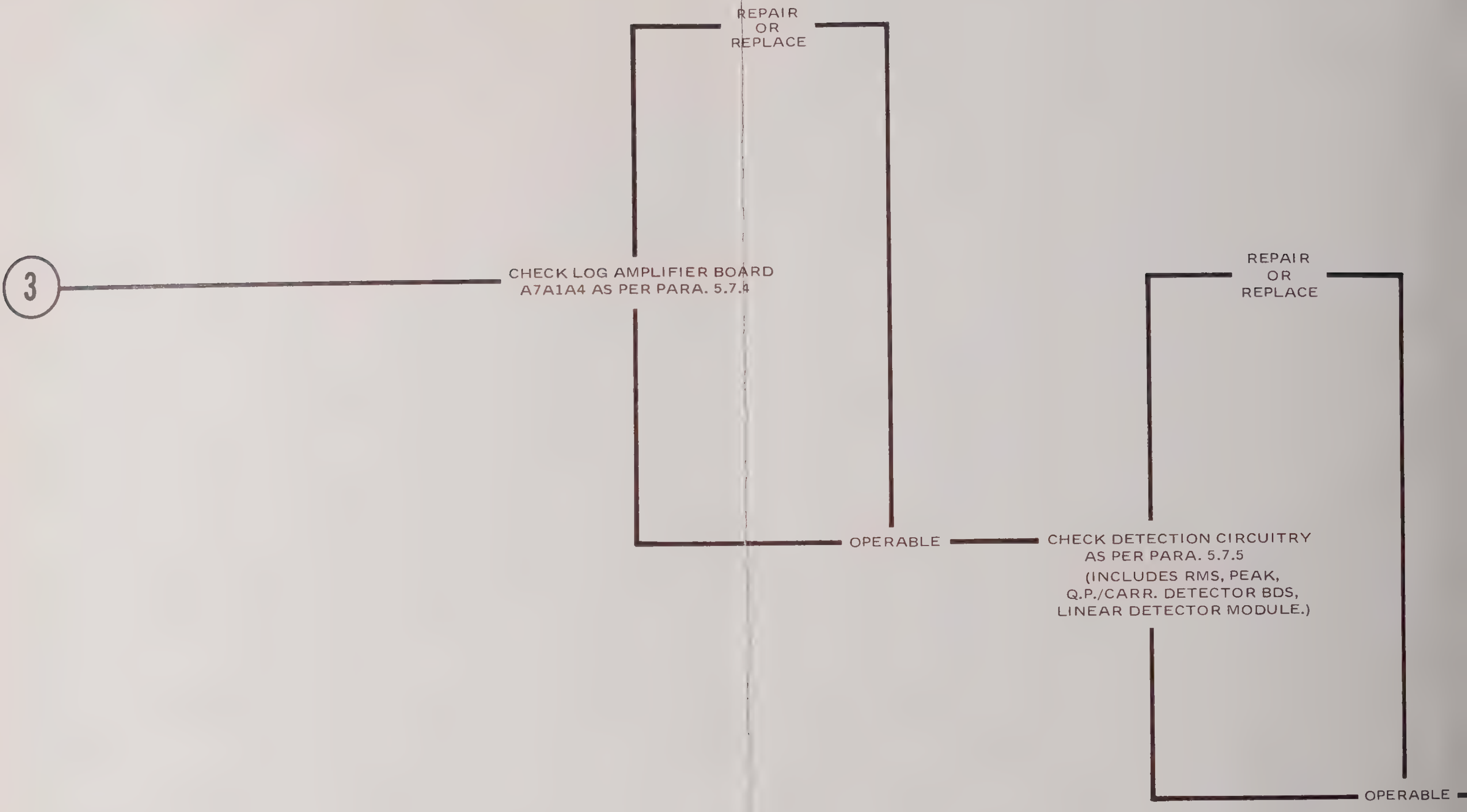


Figure 5.2

Power Supply Checking


3
REPAIR OR REPLACE
CHECK LOG AMPLIFIER BOARD A7A1A4 AS PER PARA. 5.7.4
OPERABLE
CHECK DETECTION CIRCUITRY AS PER PARA. 5.7.5 (INCLUDES RMS, PEAK, Q.P./CARR. DETECTOR BDS, LINEAR DETECTOR MODULE.)
REPAIR OR REPLACE
OPERABLE

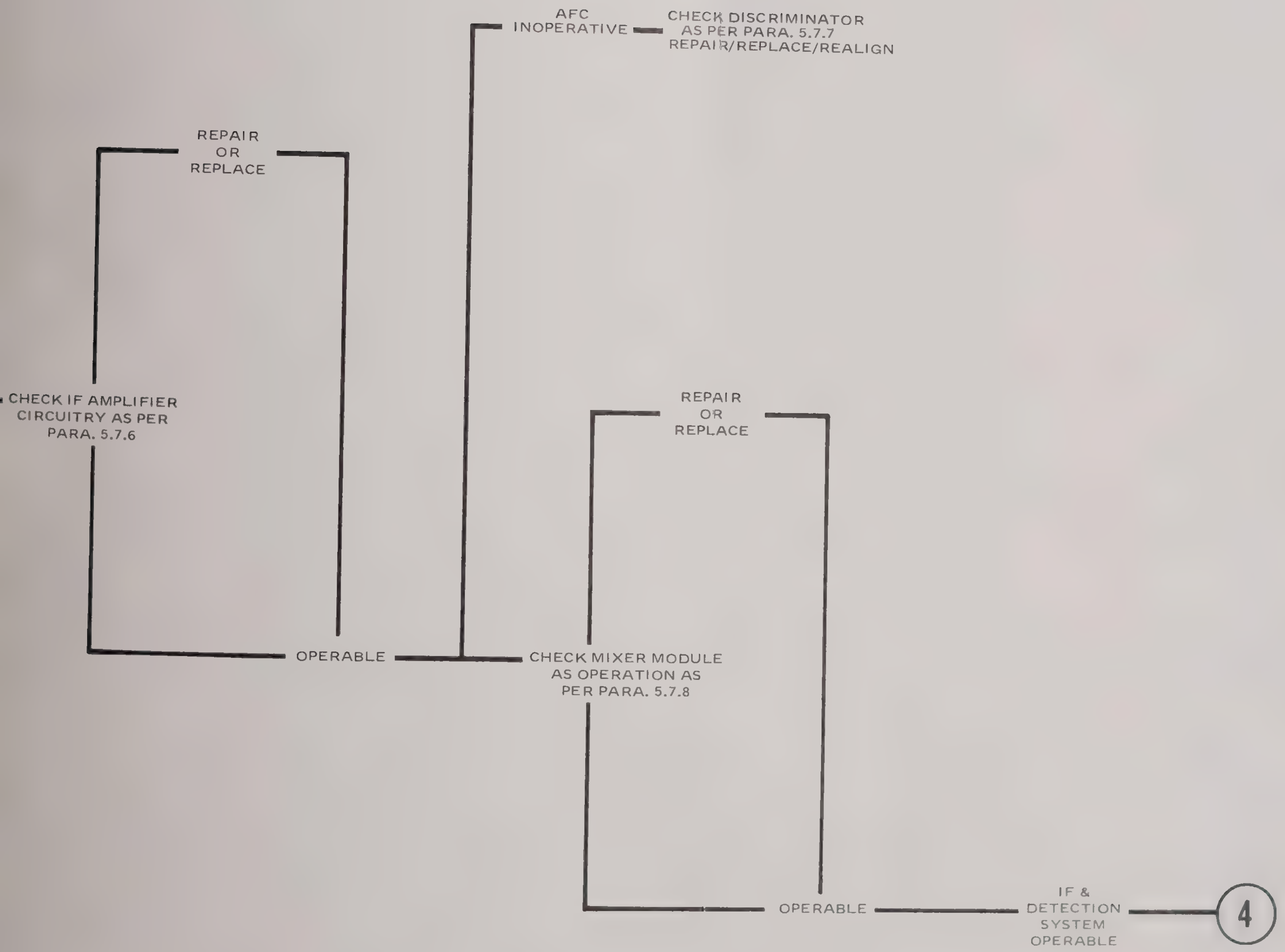
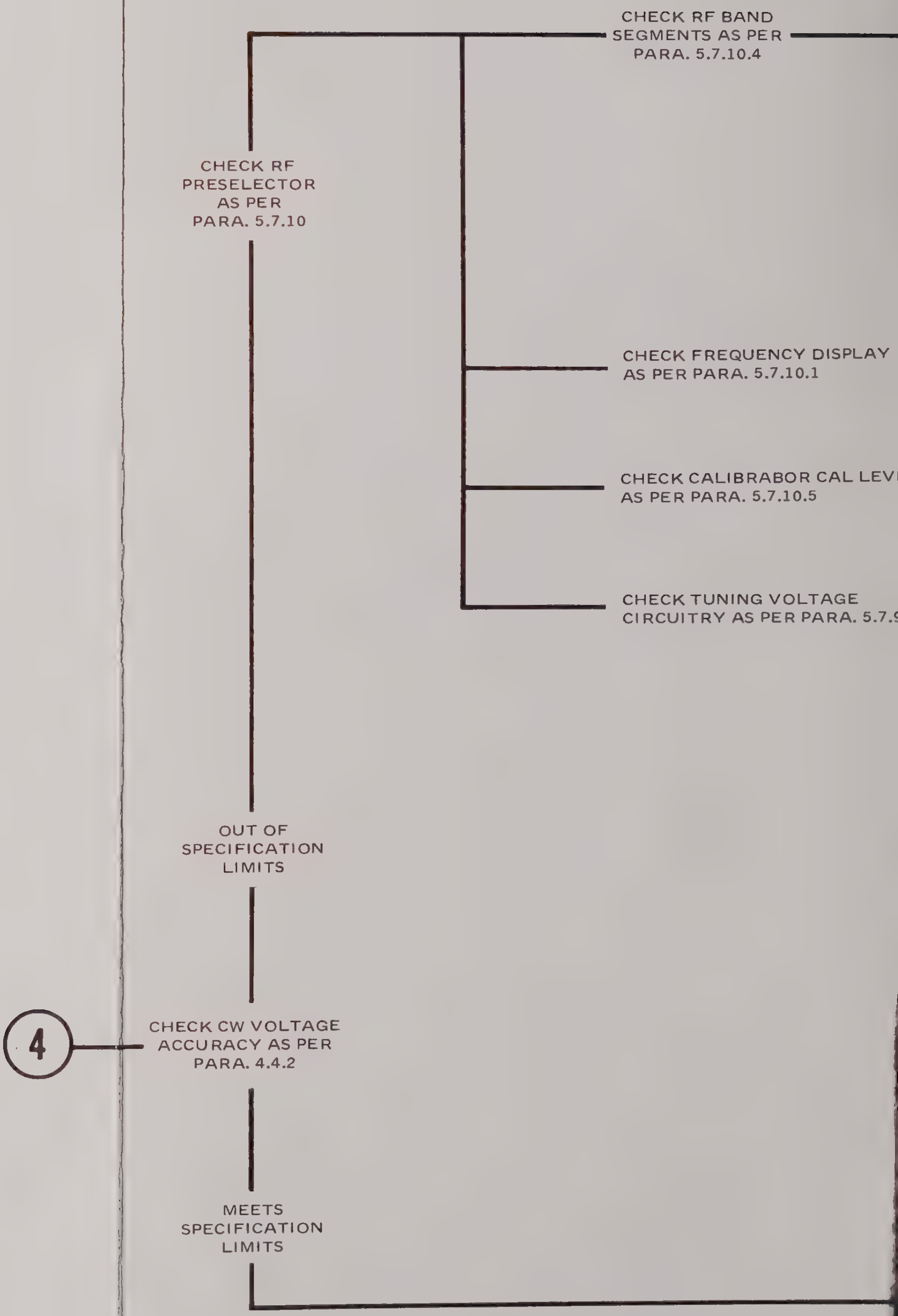

AFC INOPERATIVE
CHECK DISCRIMINATOR AS PER PARA. 5.7.7 REPAIR/REPLACE/REALIGN
REPAIR OR REPLACE
CHECK IF AMPLIFIER CIRCUITRY AS PER PARA. 5.7.6
REPAIR OR REPLACE
OPERABLE
CHECK MIXER MODULE AS OPERATION AS PER PARA. 5.7.8
OPERABLE
IF & DETECTION SYSTEM OPERABLE
4

Figure 5.3

IF and Detection System Checking


CHECK RF BAND SEGMENTS AS PER PARA. 5.7.10.4
CHECK RF PRESELECTOR AS PER PARA. 5.7.10
CHECK FREQUENCY DISPLAY AS PER PARA. 5.7.10.1
CHECK CALIBRABOR CAL LEV
AS PER PARA. 5.7.10.5
CHECK TUNING VOLTAGE CIRCUITRY AS PER PARA. 5.7.
OUT OF SPECIFICATION LIMITS
4
CHECK CW VOLTAGE ACCURACY AS PER PARA. 4.4.2
MEETS SPECIFICATION LIMITS

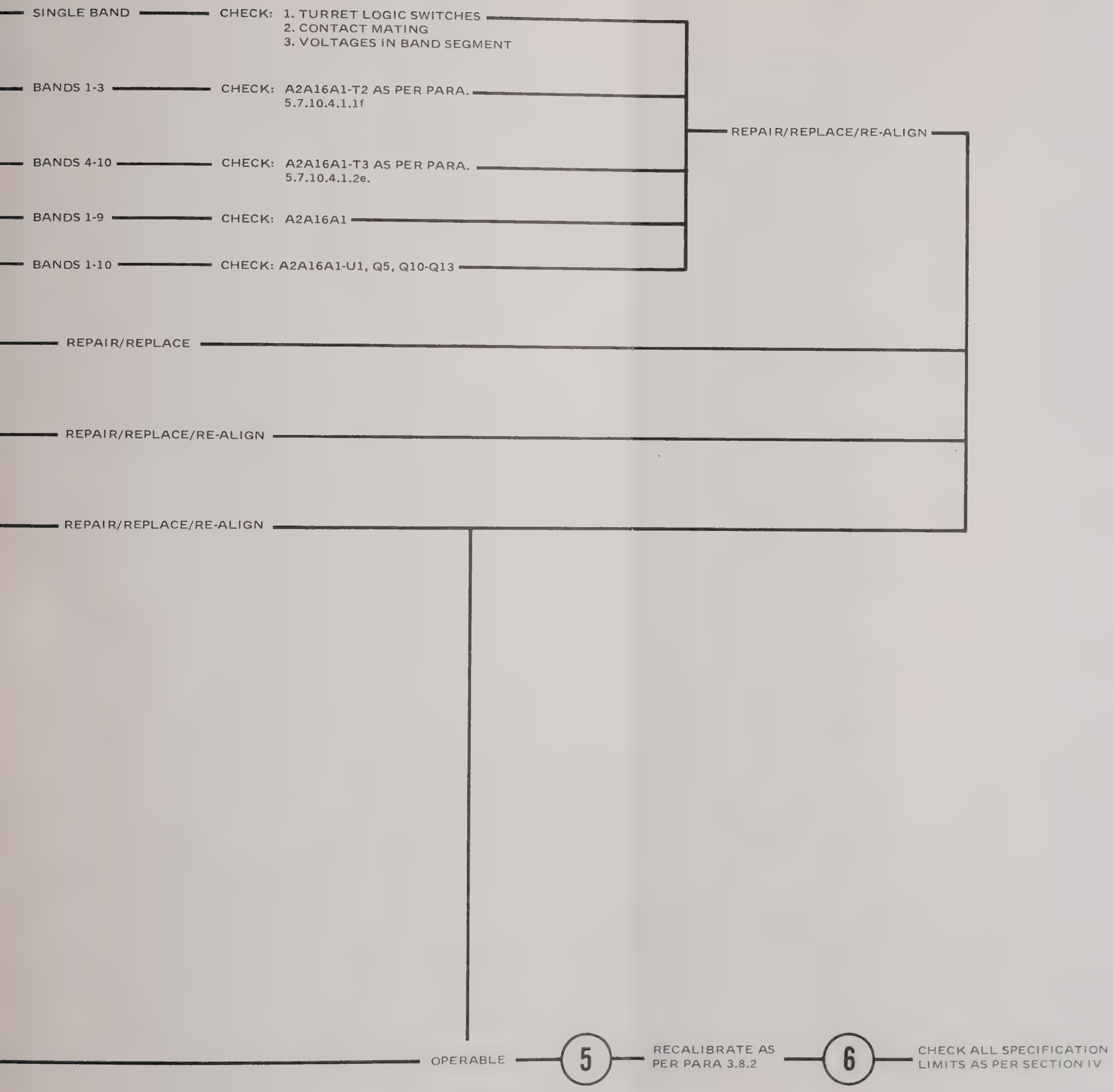

SINGLE BAND
CHECK: 1. TURRET LOGIC SWITCHES
2. CONTACT MATING
3. VOLTAGES IN BAND SEGMENT
BANDS 1-3
CHECK: A2A16A1-T2 AS PER PARA. 5.7.10.4.1.1f
REPAIR/REPLACE/RE-ALIGN
BANDS 4-10
CHECK: A2A16A1-T3 AS PER PARA. 5.7.10.4.1.2e.
BANDS 1-9
CHECK: A2A16A1
BANDS 1-10
CHECK: A2A16A1-U1, Q5, Q10-Q13
REPAIR/REPLACE
REPAIR/REPLACE/RE-ALIGN
REPAIR/REPLACE/RE-ALIGN
OPERABLE
5
RECALIBRATE AS PER PARA 3.8.2
6
CHECK ALL SPECIFICATION LIMITS AS PER SECTION IV

Figure 5.4

Calibrator and RF Preselector Checking

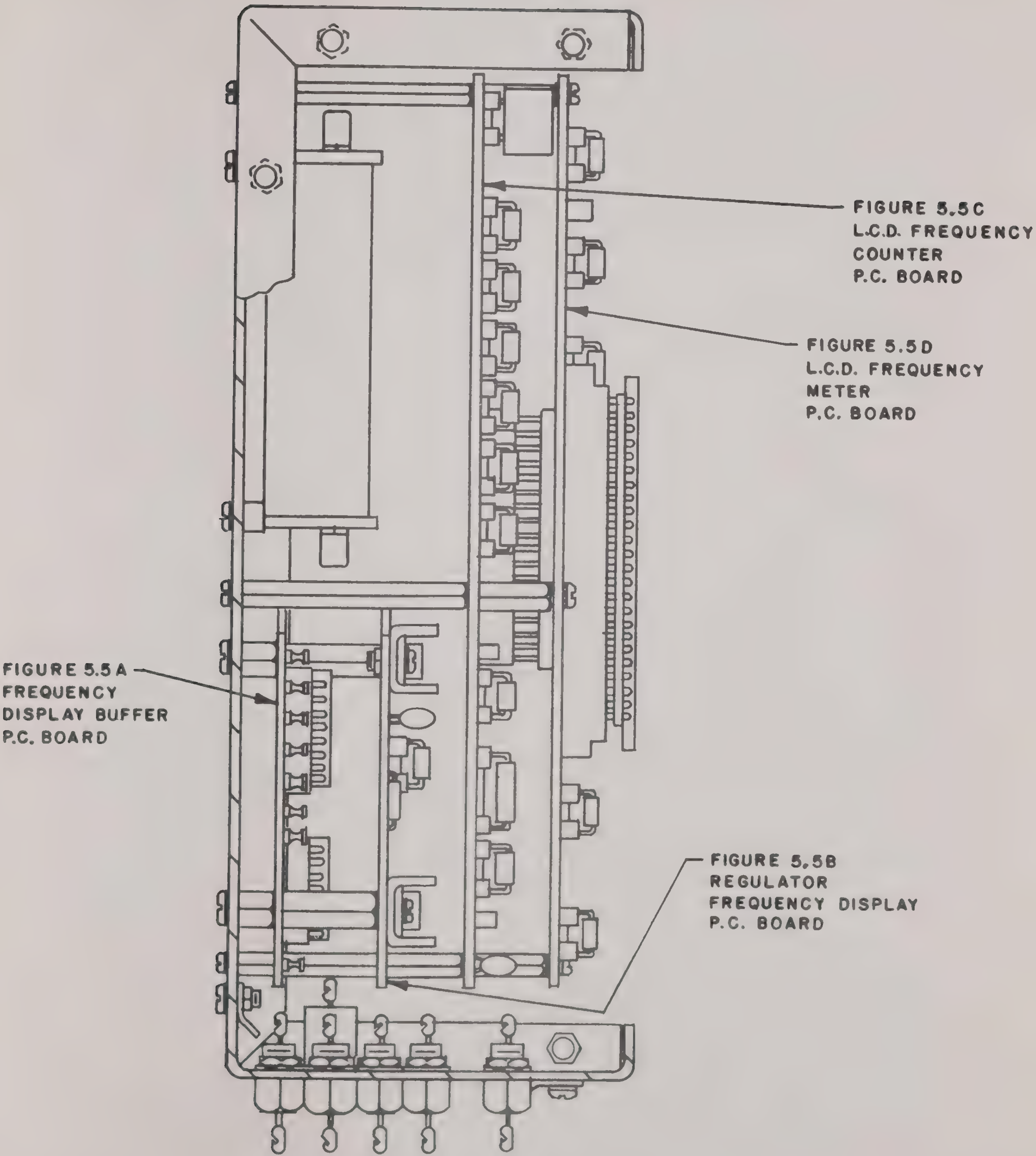


FIGURE 5.5

FREQUENCY DISPLAY ASSEMBLY

A1A3 CPR-25

E1	BCD 1 OUTPUT
E2	DIGIT 4 STROBE
E3	DIGIT 5 STROBE
E4	+5 V INPUT
E5	DIGIT 6 STROBE
E6	DIGIT 1 STROBE
E7	DIGIT 2 STROBE
E8	DIGIT 3 STROBE
E9	GND
E10	$\overline{\text{WE}}$ READ ENABLE
E11	DIGIT 4 ADDRESS
E12	DIGIT 2 ADDRESS
E13	DIGIT 1 ADDRESS
E14	WE WRITE ENABLE
E15	BCD 2 INPUT
E16	BCD 1 INPUT
E17	BCD 4 INPUT
E18	BCD 8 INPUT
E19	BCD 4 OUTPUT
E20	BCD 2 OUTPUT
E21	BCD 8 OUTPUT

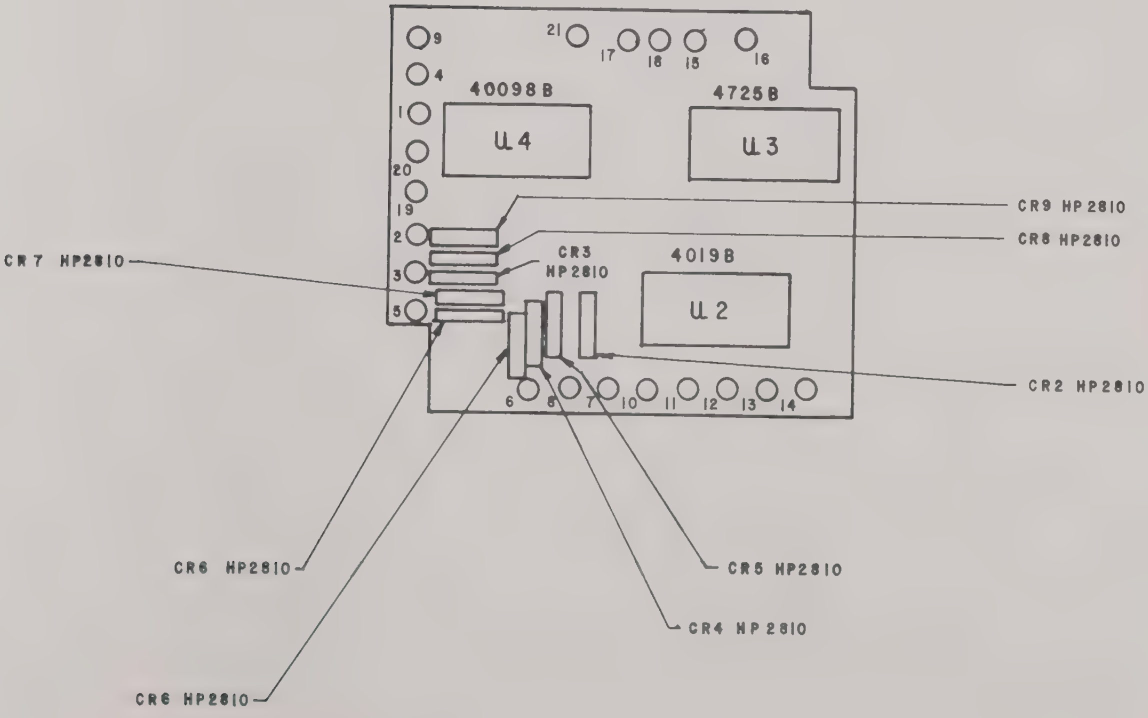


FIGURE 5.5A

FREQUENCY DISPLAY BUFFER

P.C. BOARD

A1A3A1 CPR-25

E1	+5V IN
E2	+ RAW
E3	SCALER IN
E4	TO SCALER
E5	BANDS 1-9 OUT
E6	GND
E7	SWITCHED TO +7 V TO SCALER
E8	LOCAL "DISPLAY OFF"
E9	REMOTE "DISPLAY OFF"
E10	RELAY DRIVE BANDS 11-15
E11	+12V SUPPLY OUT
E13	GND
E14	L.O. IN

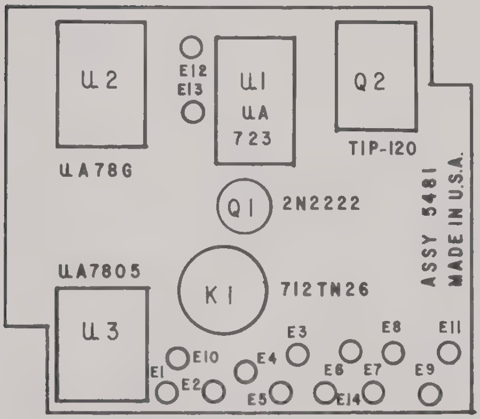


FIGURE 5.5B

REGULATOR FREQUENCY DISPLAY

P.C. BOARD

A1A3A2 CPR-25

E1	BAND CODE 8 IN
E2	BAND CODE 4 IN
E3	BAND CODE 2 IN
E4	BAND CODE 1 IN
E6	+12 V
E7	+12 V INPUT
E12	GND
E13	GND
A	BANDS 1-9 OUTPUT
B	FREQUENCY SCALING OUTPUT (BANDS 10-15)
C	RELAY DRIVE
D	+5V INPUT

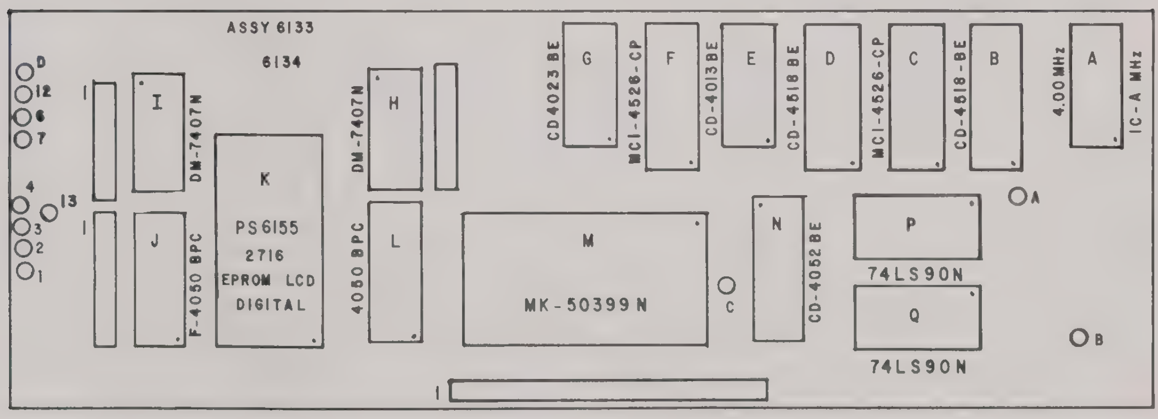


FIGURE 5.5C

LCD FREQUENCY COUNTER

PC BOARD

A1A3A3 CPR-25

E14	BCD 1 INPUT
E15	BCD 8 INPUT
E16	BCD 2 INPUT
E17	BCD 4 INPUT
E19	DIGIT 6 STROBE
E20	DIGIT 5 STROBE
E21	DIGIT 4 STROBE
E22	DIGIT 3 STROBE
E23	DIGIT 2 STROBE
E24	DIGIT 1 STROBE

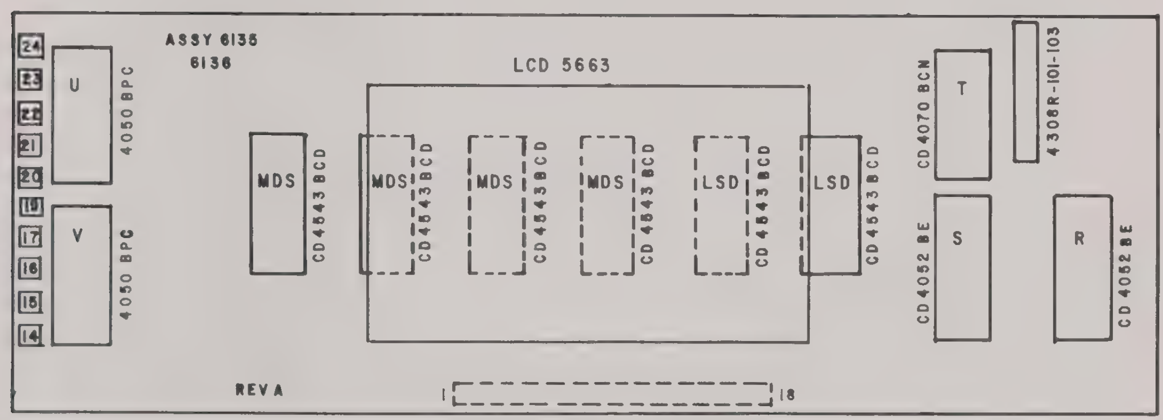


FIGURE 5.5 D

L.C.D. FREQUENCY METER

P.C. BOARD

A1A3A4 CPR-25

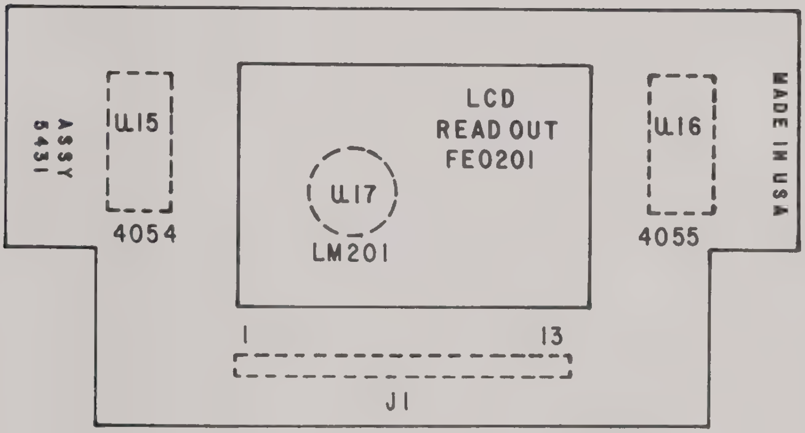


FIGURE 5.6

ATTENUATOR DISPLAY P C BOARD
A1A4 CPR-25

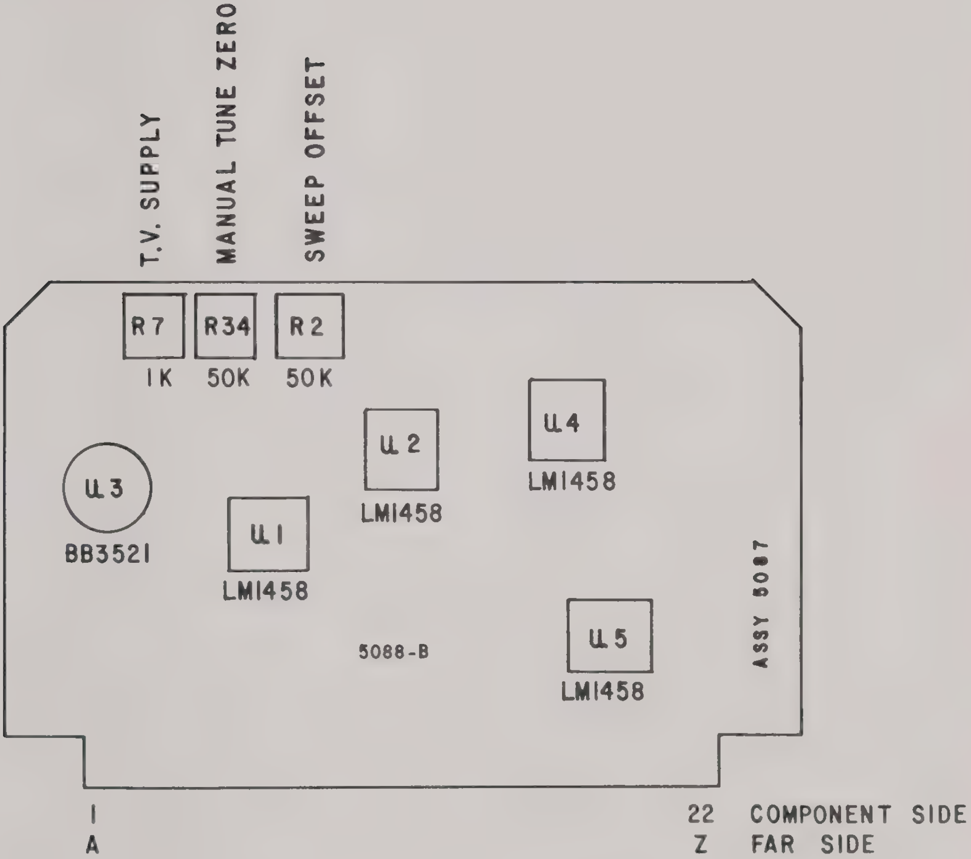


FIGURE 5.7

SWEEP CONTROL

P.C. BOARD

AIA5 CPR-25

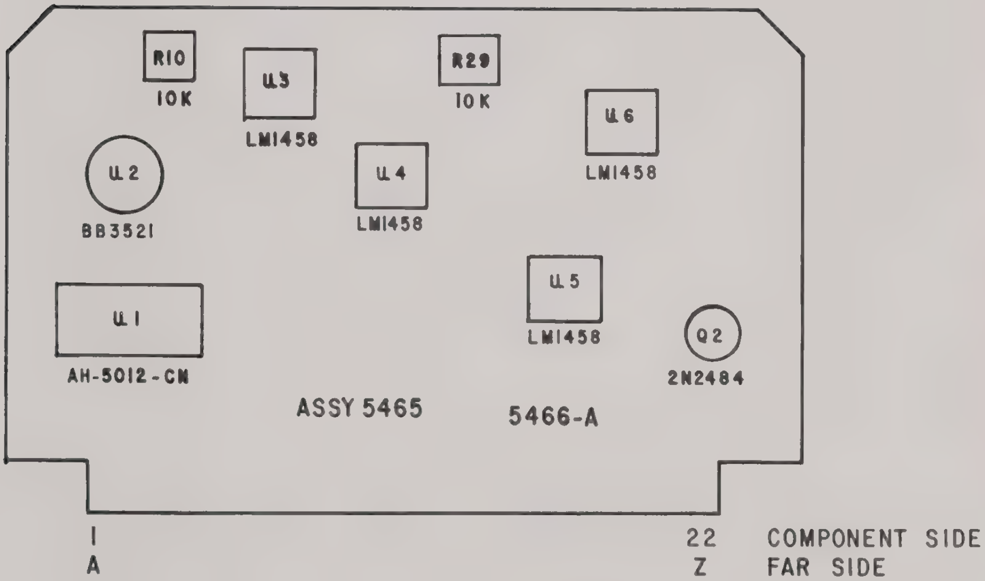
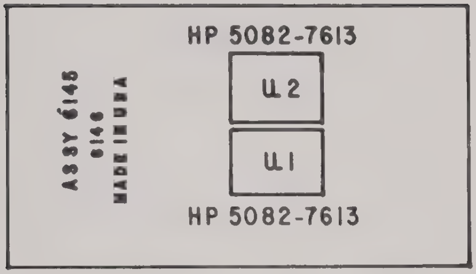


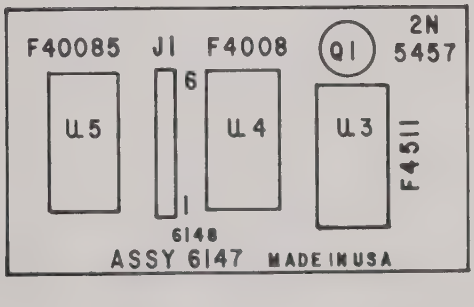
FIGURE 5.8

SWEEP P.C. BOARD

AIA6 CPR-25



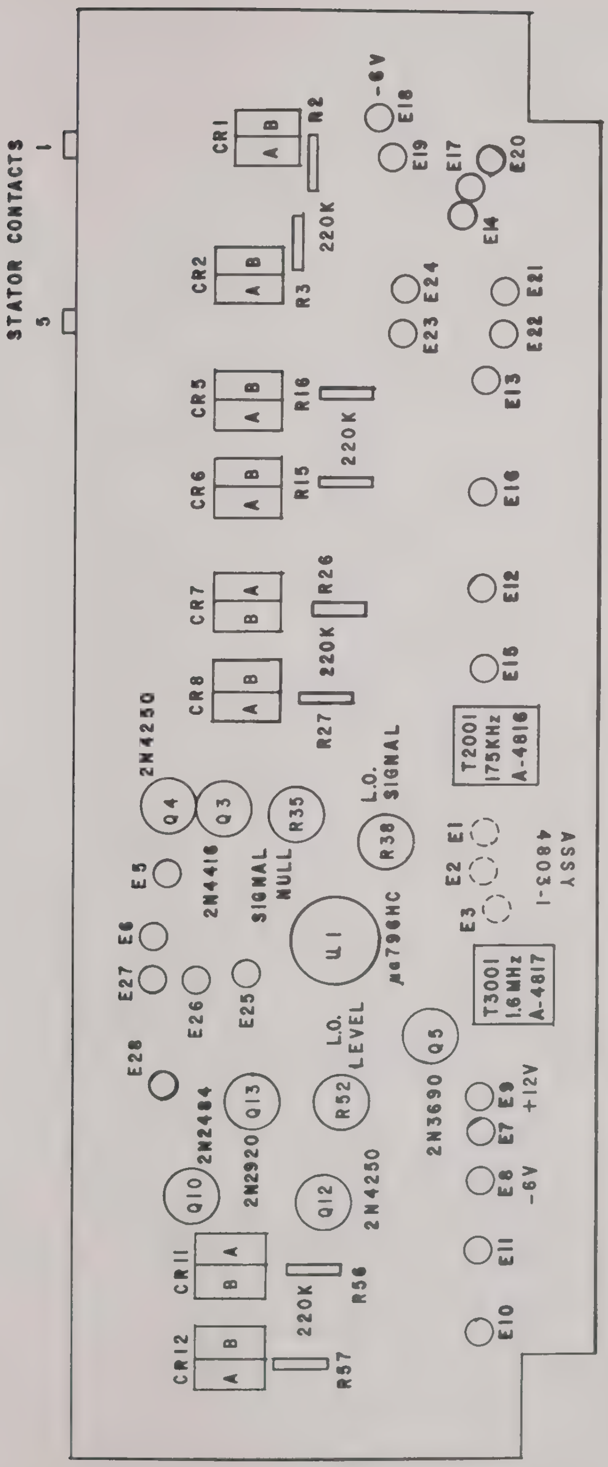
BAND INDICATOR
DISPLAY PC BOARD
A1A7 CPR-25



BAND INDICATOR
DRIVER P.C BOARD
A1A8 CPR-25

FIGURE 5.9

A1A7/A1A8 BOARDS



E7	HV TUNE IN
E8	-6V
E9	+12V
E10	500 MV CR12 A & B
E11	500 MV CR11 A & B
E12	500 MV CR7 A & B
E13	500 MV CR5 A & B
E14	500 MV CR2 A & B
E15	200 MV CR8 A & B
E16	200 MV CR6 A & B
E17	BIAS CHECK CR1 A & B
E18	-6V
E28	CHECK L.O. LEVEL

FIGURE 5.10
R.F. PRESELECTOR-STATOR
P.C. BOARD
A2A16A1 CPR-25

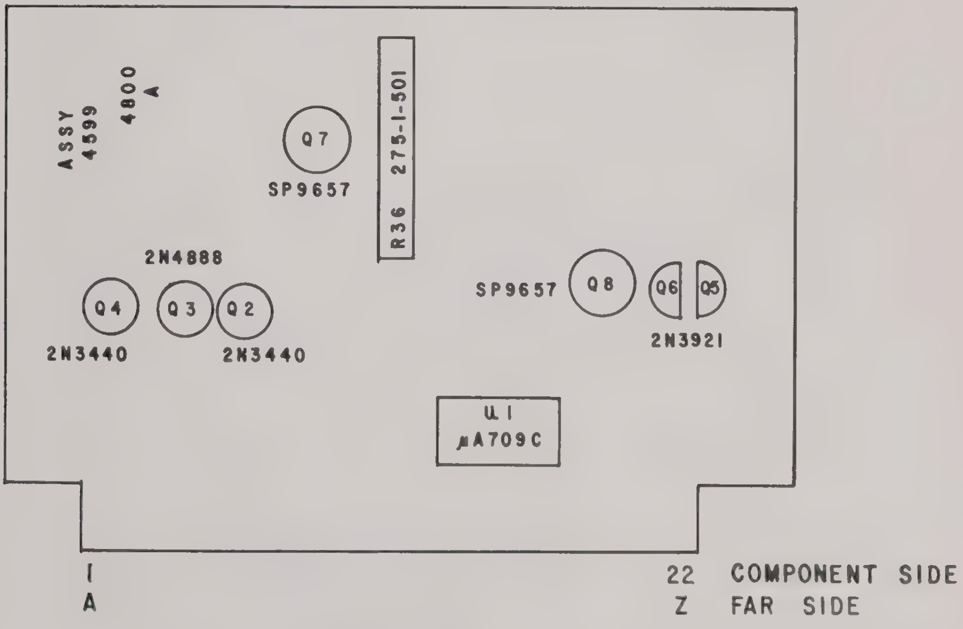


FIGURE 5.11

TUNING REGULATOR

P.C. BOARD

A2A16A2 CPR-25

E1 +RAW
E2 GND
E3 CAL COMMAND
E4 -12V
E5 SOL
E6 SOL
E7 RELAY

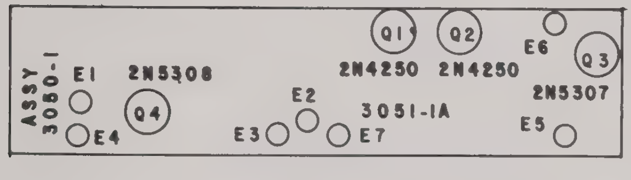


FIGURE 5.12
IMPULSE GENERATOR
DRIVE CIRCUIT P C BOARD
A2A17A1 CPR-25

E1	$\overline{10}$ OUT
E2	$\overline{20}$ OUT
E3	$\overline{40}$ OUT
E4	10 OUT
E5	20 OUT
E6	40 OUT
E7	+ RAW
E8	10 IN
E9	20 IN
E10	40 IN
E11	GND

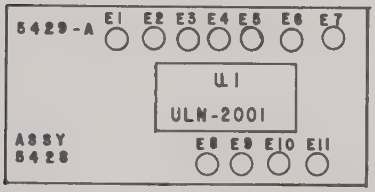
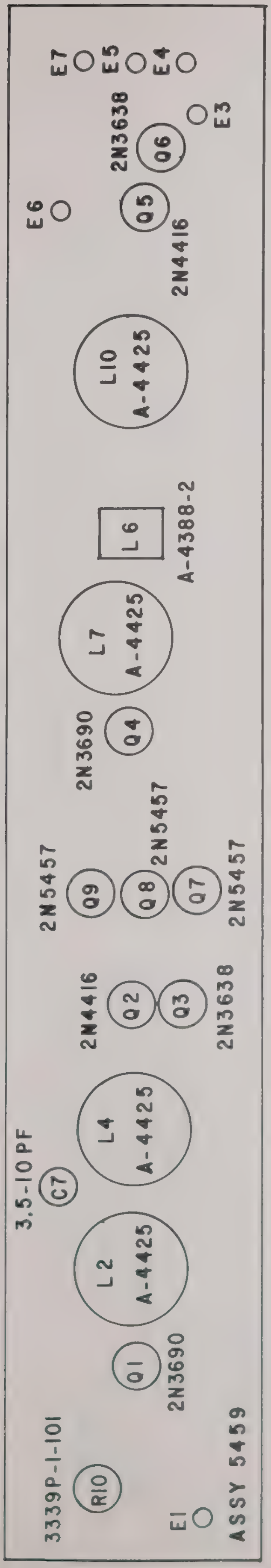


FIGURE 5.13

ATTENUATOR DRIVE

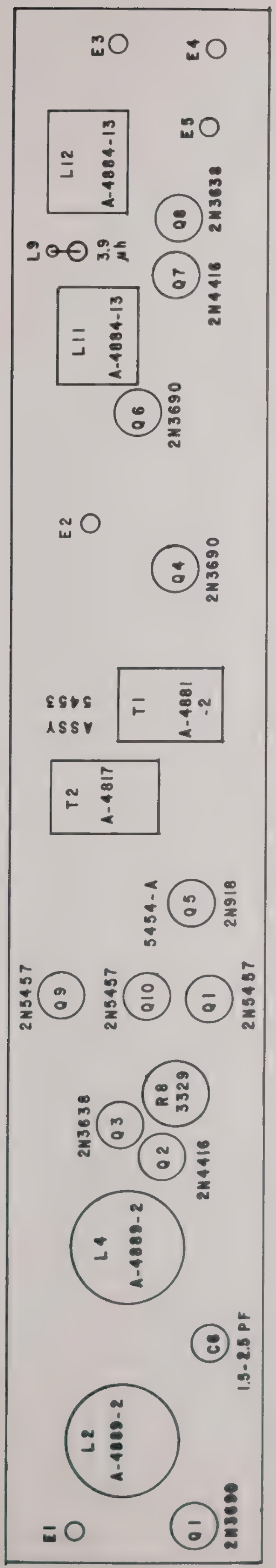
P.C. BOARD

A2A19 CPR-25



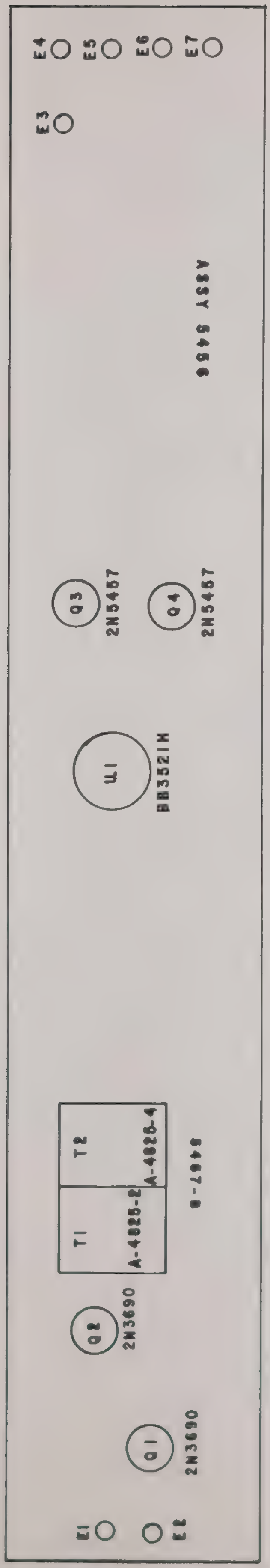
E1	IF INPUT
E3	+ 12 V
E4	0 dB LOGIC IN
E5	10 dB LOGIC IN
E6	− 6 V
E7	20 dB LOGIC

FIGURE 5.14
IF AMPLIFER
1.6 MHz - 9KHz B.W.
P.C. BOARD
A3A1 CPR-25



E1 IF INPUT
E2 TEST POINT
E3 + 12V
E4 – 6V
E5 IF OUTPUT

FIGURE 5.15
IF AMPLIFIER
8.7 MHz-120 KHz B.W.
P.C. BOARD
A3A2 CPR-25



E1	IF INPUT
E2	GND
E3	+ 12 V
E4	SIGNAL OUTPUT
E5	COMMAND BANDS 1-3 LOGIC
E6	COMMAND BANDS 4-10 LOGIC
E7	– 12 V

FIGURE 5.16
IF AMPLIFIER
DISCRIMINATOR P.C. BOARD
A3A3 CPR-25

E1 +RAW (+20V)
E2 +12V
E3 INPUT FROM GAIN POT WIPER
E4 1.6 MHz IF INPUT
E5,E9,E11 GND
E6 −RAW (−12V)
E7 FM OUTPUT TO DISCRIMINATOR
E8 VIDEO OUTPUT
E10 IF OUTPUT TO REAR PANEL

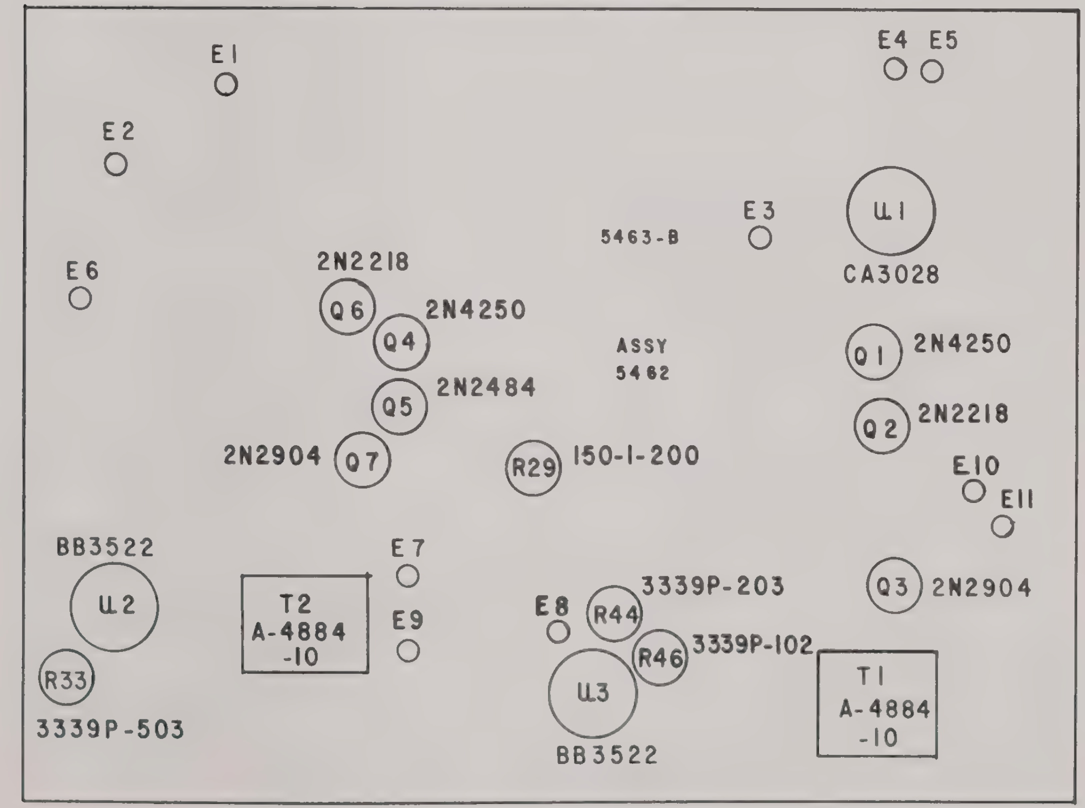


FIGURE 5.17

LINEAR DETECTOR
DRIVER P.C. BOARD
A4A1 CPR-25

E1	BAND 7 SWITCHED (+12V)
E2	BANDS 1,2,+3 SWITCHED (+12V)
E3	175 KHz IN
E4	LOGIC OUT
E5	BANDS 4,5,6,8,9+10 SWITCHED
E6	1.6 MHz IN
E7	1.6 MHz OUT
E8	+12V
E9	8.7 MHz OUT
E10	RF/IF BANDS 11-15
E11	VFO BANDS 11-12
E12	BANDS 11-12,-6V SWITCHED
E13	BAND 13 -6V SWITCHED
E14	BAND 14 -6V SWITCHED
E15	BAND 15 -6V SWITCHED
E16,E17,E18,E19	GND

TP-1 TEST POINT

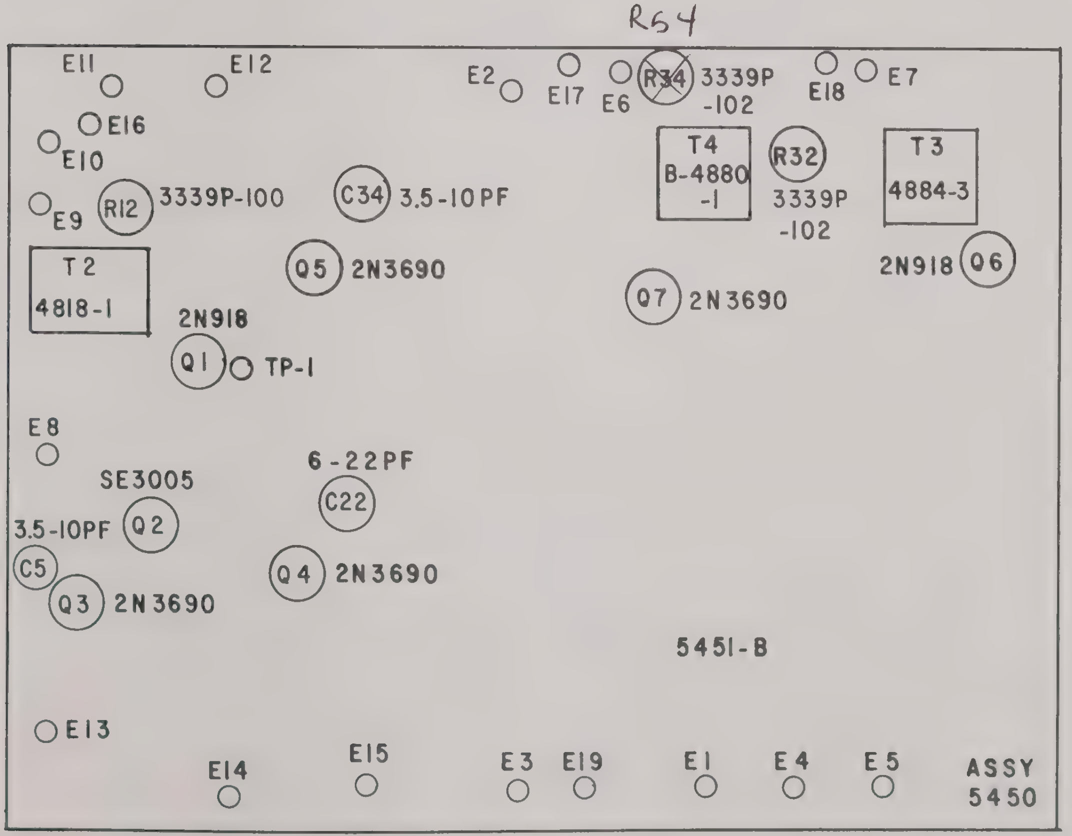


FIGURE 5.18

MIXER PC BOARD

A5A1 CPR-25

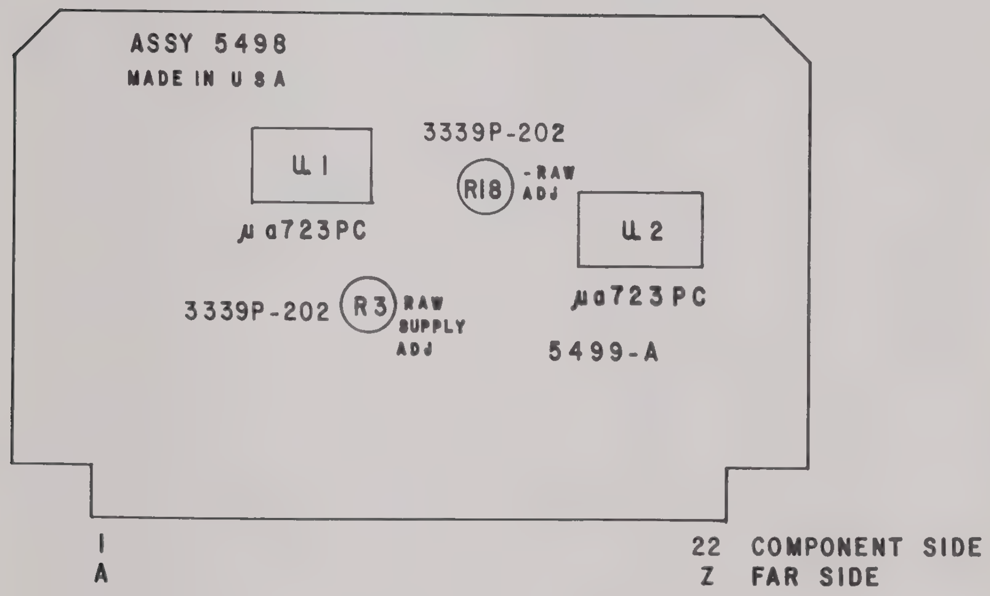


FIGURE 5.19
POWER SUPPLY
P.C. BOARD
A6A1A1 CPR-25

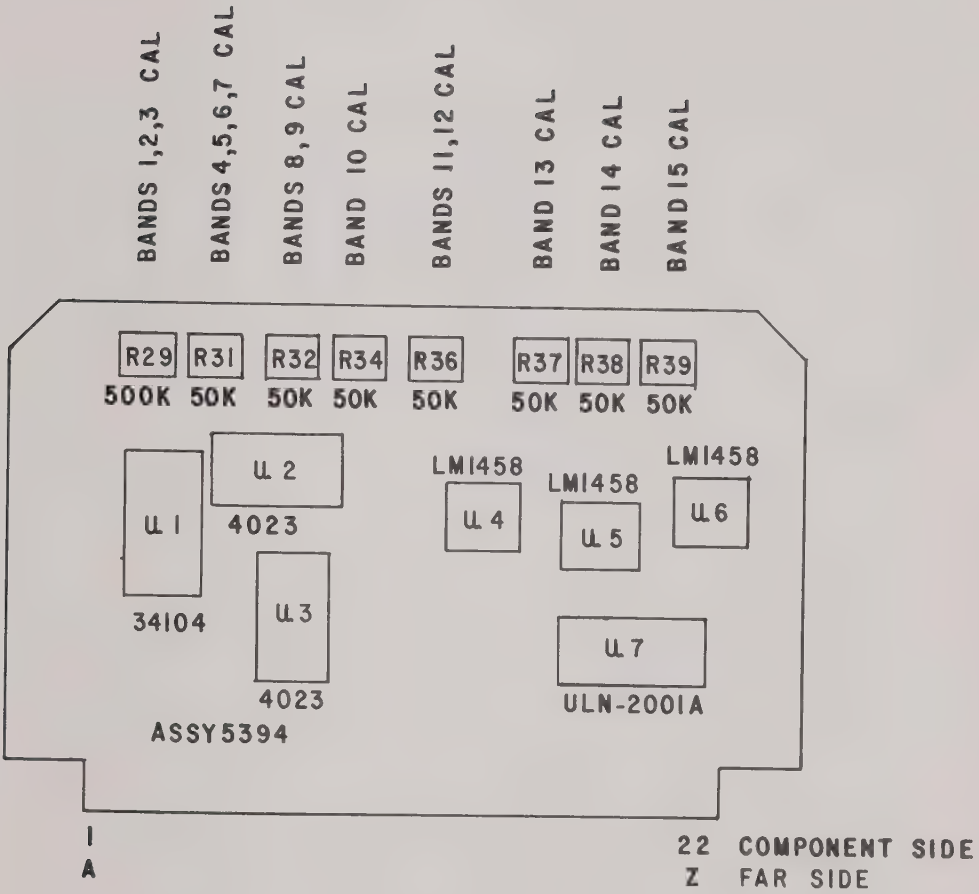


FIGURE 5.20
I.F./MIXER CONTROL
P.C. BOARD
A6A2 CPR-25

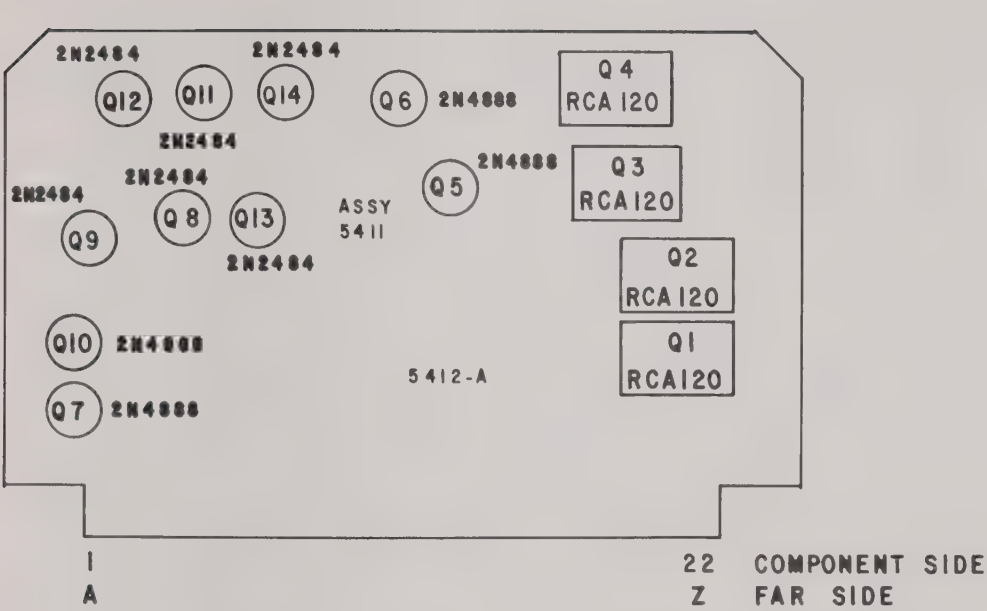


FIGURE 5.21
BAND CONTROL
P.C. BOARD
A6A3 CPR-25

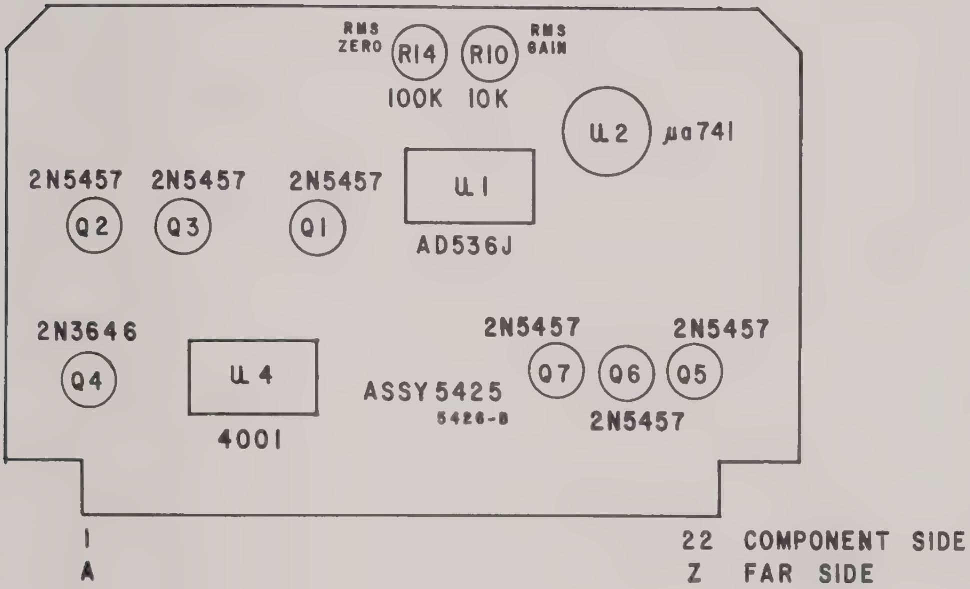


FIGURE 5.22

RMS DETECTOR
P.C. BOARD
A7A1A1 CPR-25

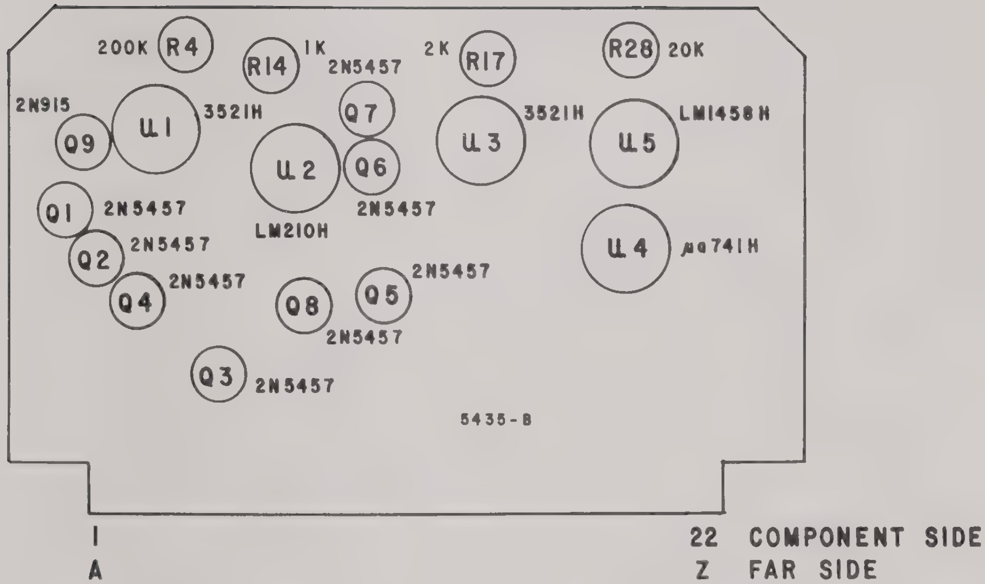


FIGURE 5.23
PEAK DETECTOR
P.C. BOARD
A7A1A2 CPR-25

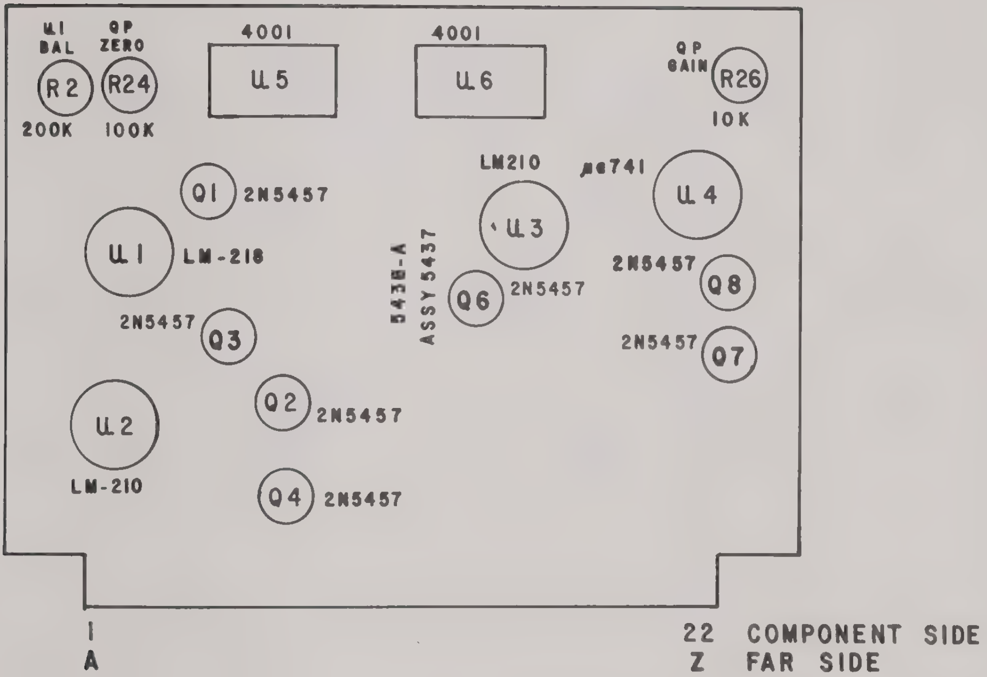


FIGURE 5.24

QUASI-PEAK/CARRIER DECTECTOR

P.C. BOARD

A7A1A3 CPR-25

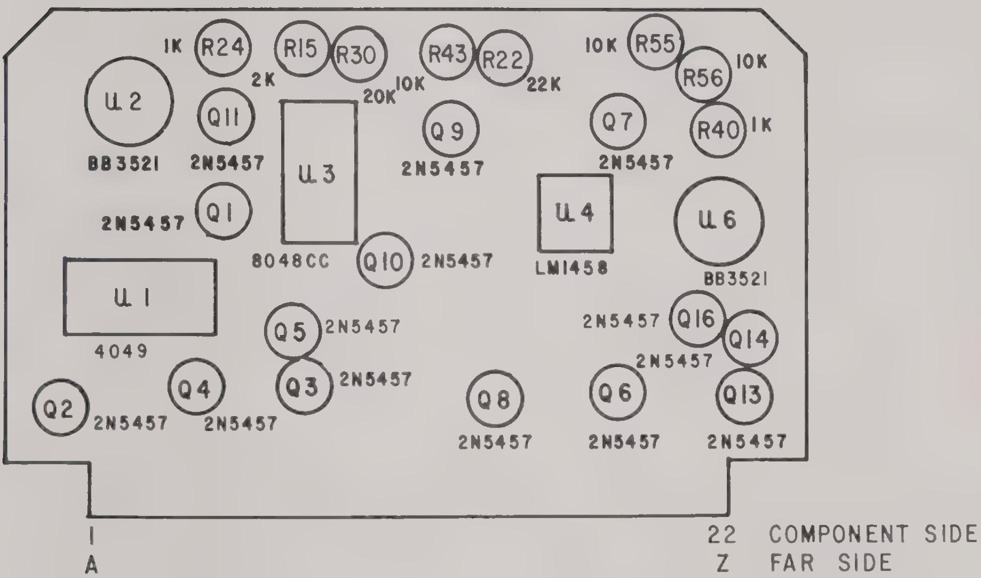


FIGURE 5.25

LOG AMPLIFIER

P.C. BOARD

A7A1A4 CPR-25

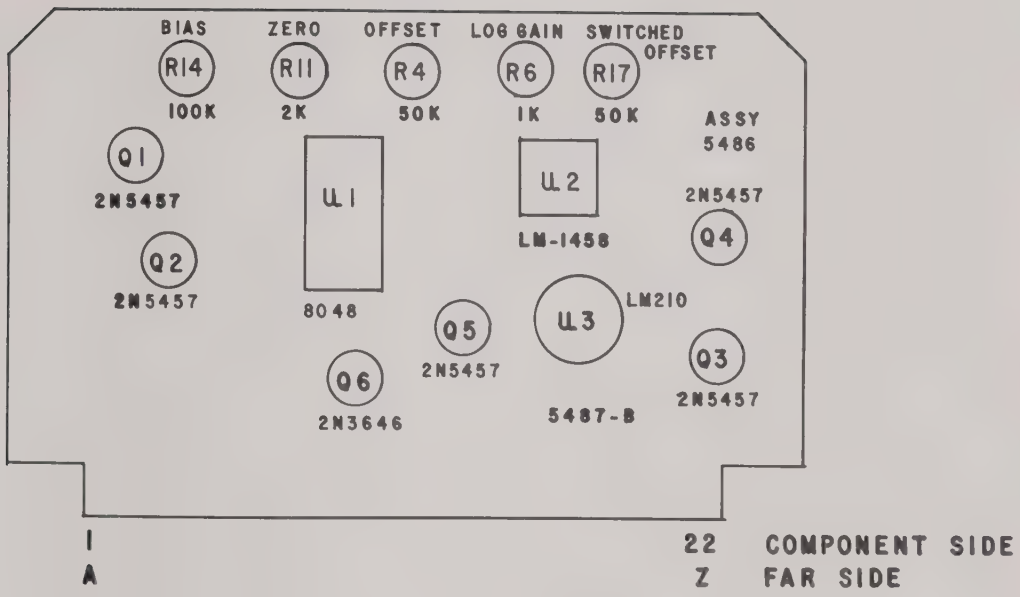


FIGURE 5.26
PEN NO.2 DRIVER
P.C. BOARD
A7A1A5 CPR-25

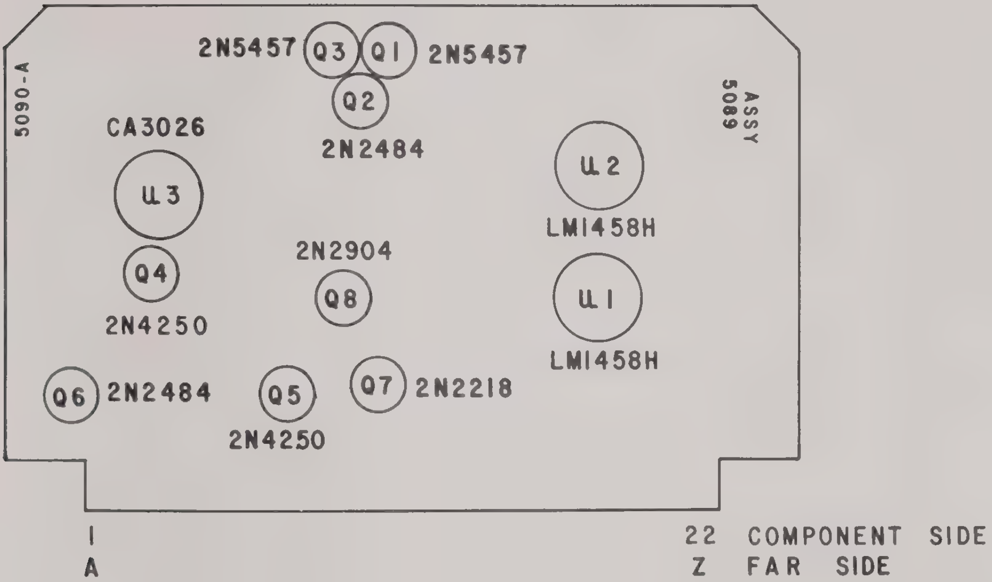


FIGURE 5.27

AUTO-SWEEP/AUDIO AMP

P.C. BOARD

A7A1A6 CPR-25

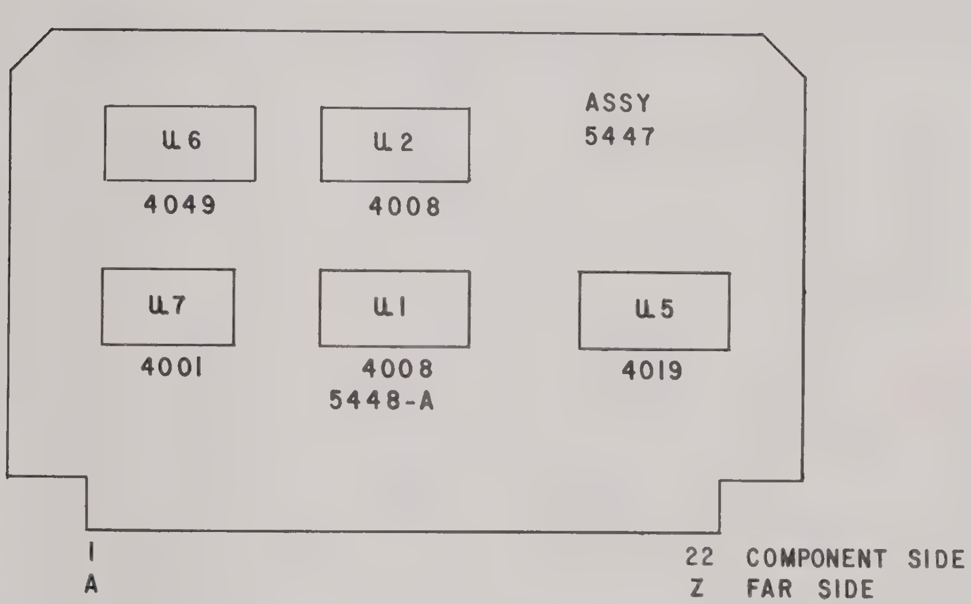


FIGURE 5.28

ATTENUATOR CONTROL "C"
P.C.BOARD
A7A1A8 CPR-25

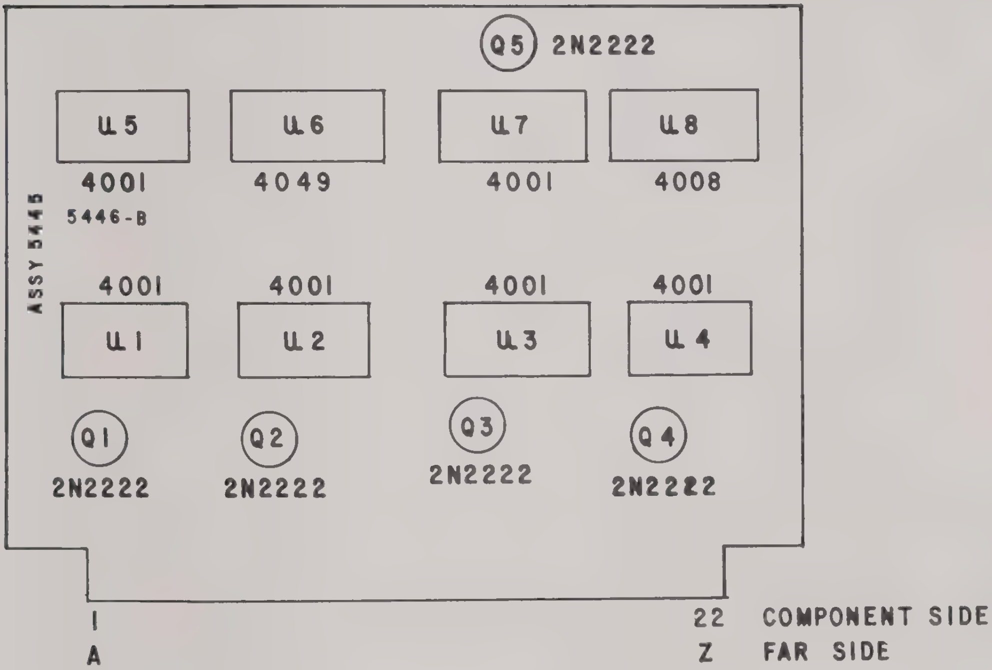


FIGURE 5.29
ATTENUATOR CONTROL "B"
P.C. BOARD
A7A1A9 CPR-25

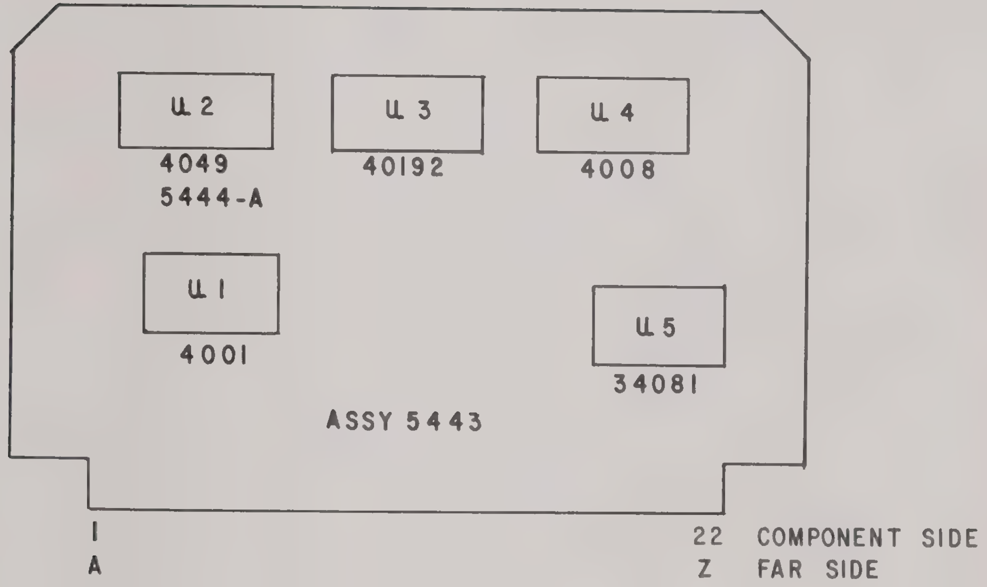


FIGURE 5.30

ATTENUATOR CONTROL "A"
P.C. BOARD
A7A1A10 CPR-25

NOTES:

1. TERMINALS E1, E2 AND E3 ARE TO ALLOW REMOTE CONTROL OF DETECTOR FUNCTIONS AND RECIVER GAIN.
2. TO ALLOW LOCAL CONTROL OF DETECTOR FUNCTIONS, WHEN IN REMOTE, JUMPER E1 AND E3.
3. TO ALLOW LOCAL CONTROL OF RECIEVER GAIN, WHEN IN REMOTE, JUMPER E1 AND E2.

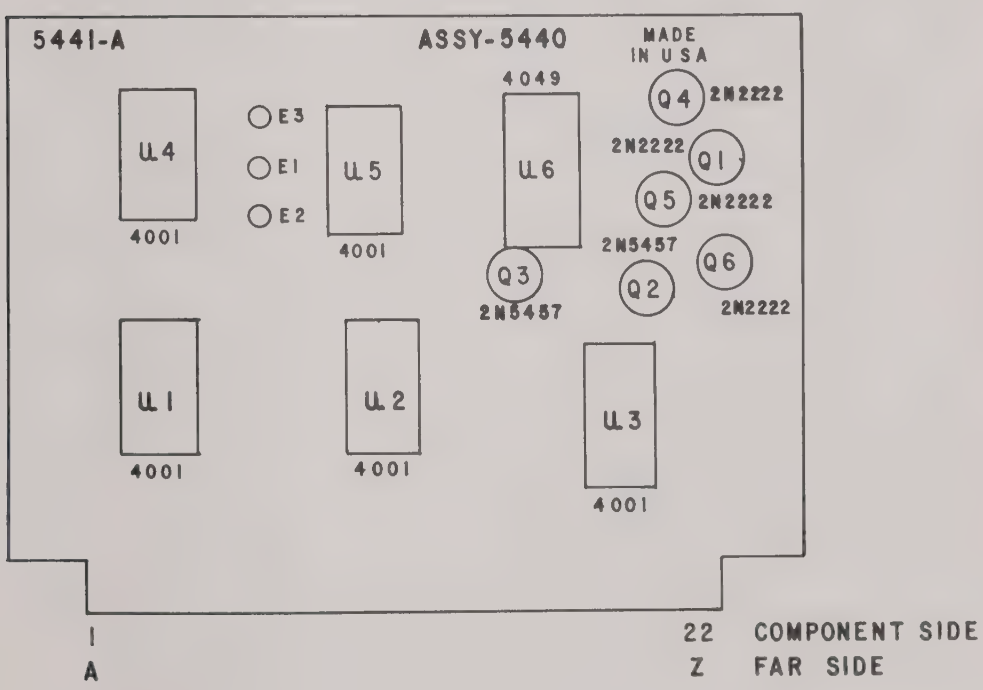


FIGURE 5.31
DETECTOR LOGIC
P.C. BOARD
A7A1A11 CPR-25

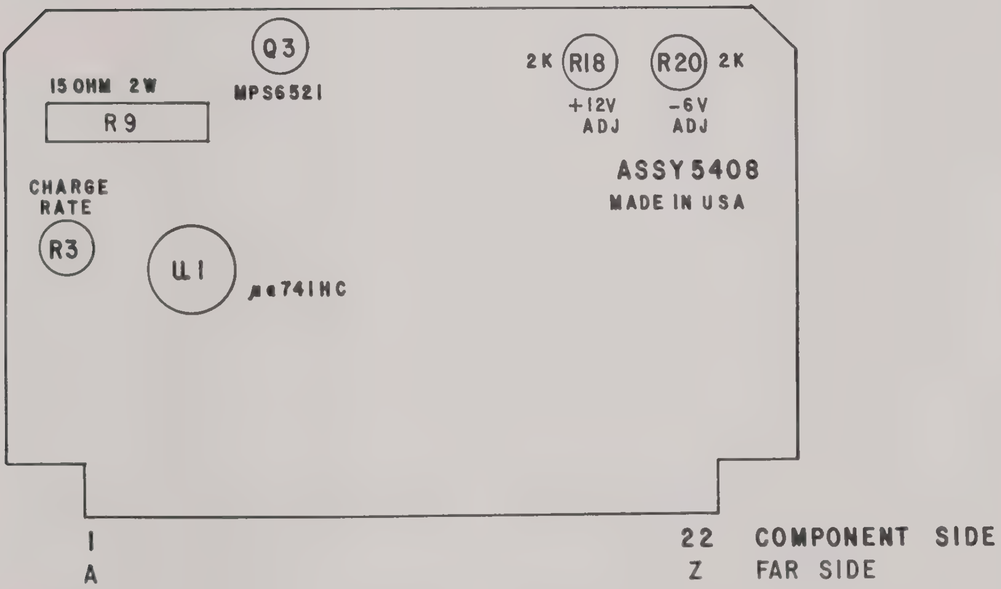
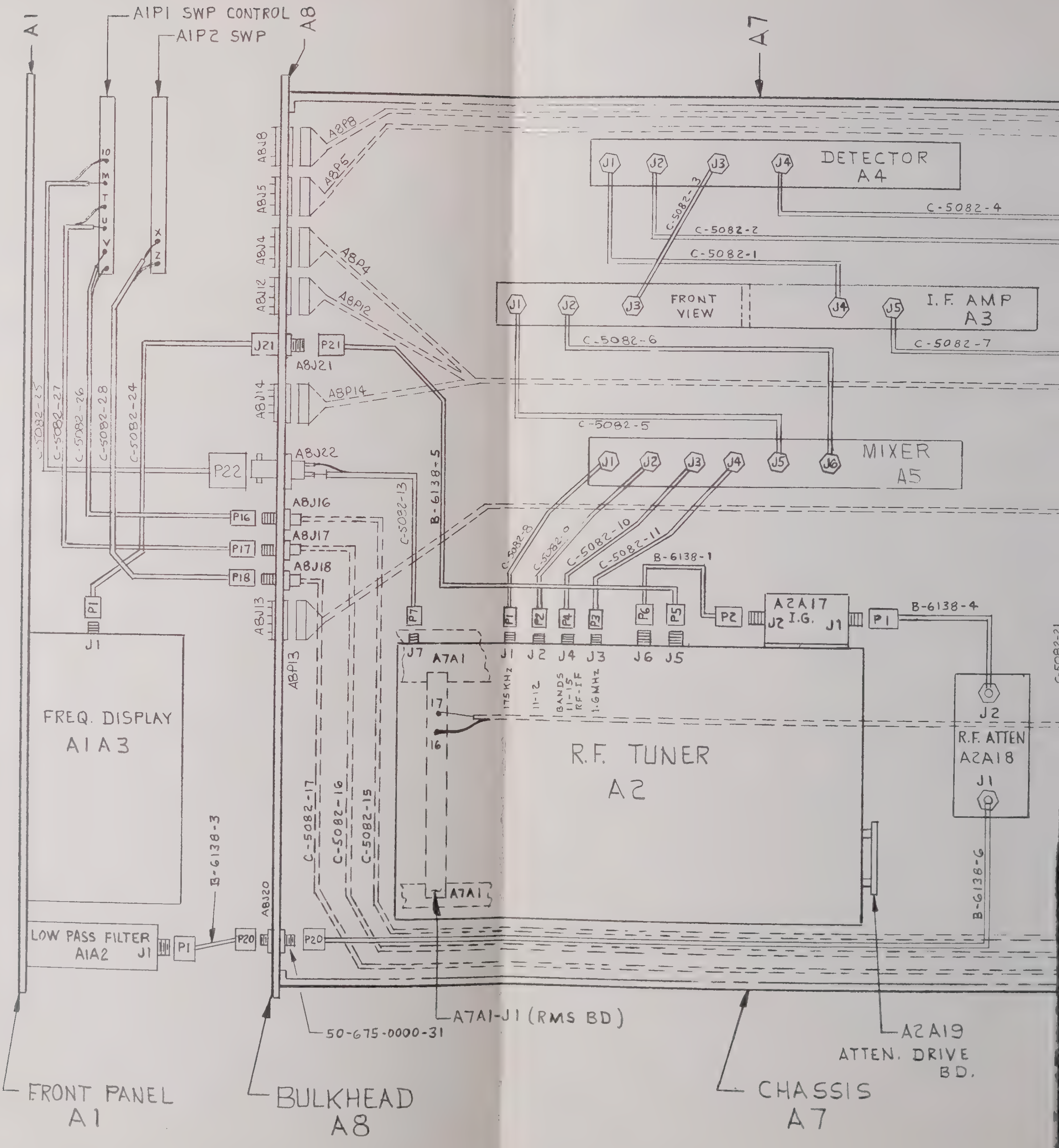


FIGURE 5.32
BATTERY CHARGER AND
LOW VOLTAGE CUT OFF
P.C. BOARD
A7A1A12 CPR-25


A1
A1P1 SWP CONTROL
A1P2 SWP
A8
A7
A8J8
A8P8
A8J5
A8P5
A8J4
A8P4
A8J12
A8P12
J21
P21
A8J21
A8J14
A8P14
A8J22
P22
A8J16
P16
A8J17
P17
A8J18
P18
A8J13
A8P13
C-5082-25
C-5082-27
C-5082-26
C-5082-28
C-5082-24
C-5082-13
B-6138-5
P1
J1
FREQ. DISPLAY
A1A3
B-6138-3
A8J20
LOW PASS FILTER
A1A2
J1
P1
P20
P20
C-5082-17
C-5082-16
C-5082-15
DETECTOR
A4
J1
J2
J3
J4
C-5082-3
C-5082-4
C-5082-2
C-5082-1
FRONT VIEW
I.F. AMP
A3
J5
C-5082-6
C-5082-7
C-5082-5
MIXER
A5
J6
C-5082-8
C-5082-9
C-5082-10
C-5082-11
B-6138-1
P7
P1
P2
P4
P3
P6
P5
J7
A7A1
J1
J2
J4
J3
J6
J5
175 KHz
11-12
BANDS 11-15 RF-IF
1.6 MHz
17
16
R.F. TUNER
A2
A7A1
A2A17
I.G.
J2
J1
P2
P1
B-6138-4
J2
R.F. ATTEN
A2A18
J1
B-6138-6
A7A1-J1 (RMS BD)
50-675-0000-31
A2A19
ATTEN. DRIVE BD.
FRONT PANEL
A1
BULKHEAD
A8
CHASSIS
A7

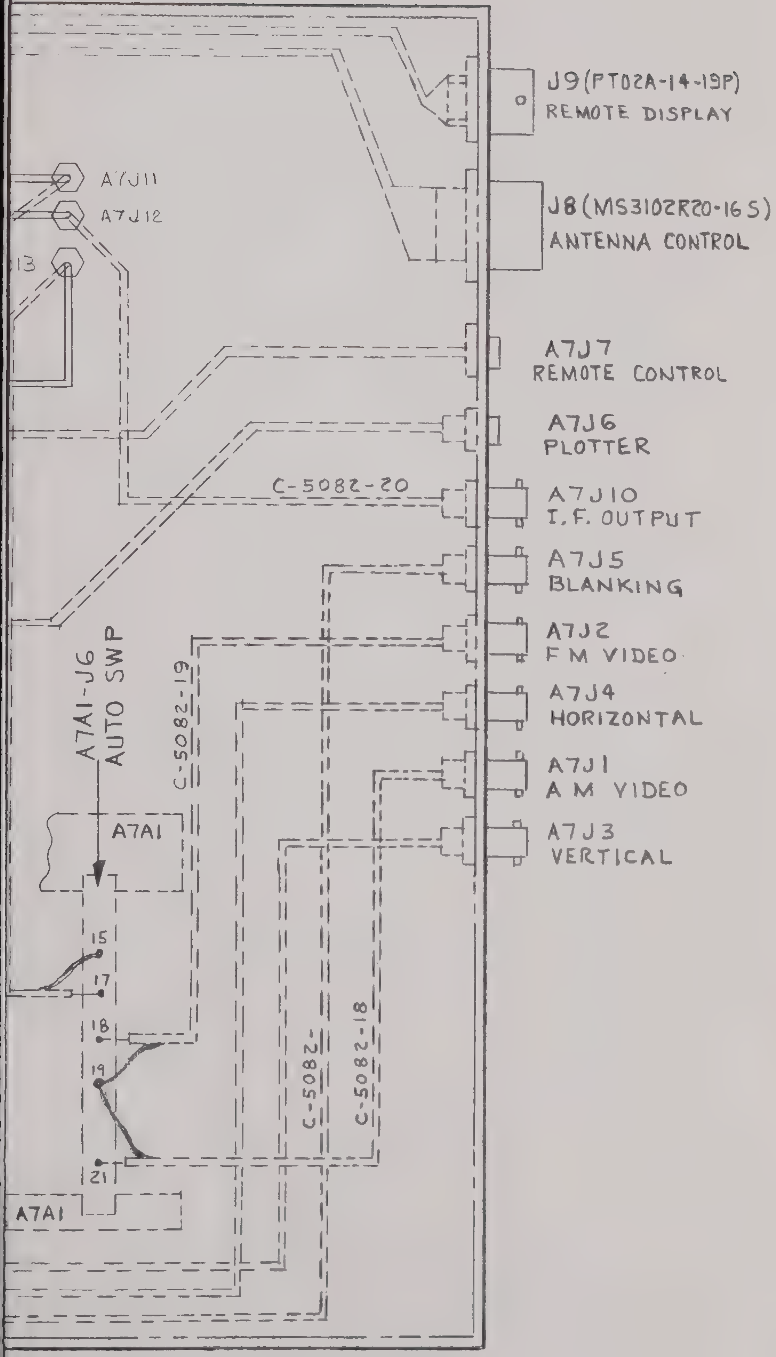


Figure 5.33
Cable Connection Diagram

SECTION VI

Reference Data

6.1 GENERAL

This section contains the unit location guides, schematics, plus other reference information for troubleshooting, repairing, and maintaining the CPR-25. The schematics are presented, as near as possible, in the order of signal flow through the instrument.

Figure	LIST OF DIAGRAMS
6.1A	Location Guide, Top View
6.1B	Location Guide, Bottom View
6.1C	Location Guide, PWR Supply Module
6.2	Location Guide, Front Bulkhead
6.3	Signal Flow Chart
6.4	Calibrator A2A17
6.5	RF Tuner/Stator Bd (A2A16A1)
6.6	RF Band Segments 1-9 (A2A1-A2A9)
6.7	RF Band Segment 10 (A2A10)
6.8	RF Band Segment 11 (A2A11)
6.9	RF Band Segment 12 (A2A12)
6.10	RF Band Segment 13 (A2A13)
6.11	RF Band Segment 14 (A2A14)
6.12	RF Band Segment 15 (A2A15)
6.13	Tuner Interconnections
6.14	LO Output Amplifier (A2A16A4)
6.15	Mixer Assembly (A5)
6.16	IF Amplifier/Discriminator Assembly (A3)
6.17	IF/MIXER Control Bd (A6A2)
6.18	Linear Detector Assembly (A4)
6.19	RMS Detector Bd (A7A1A1)
6.20	PEAK Detector Bd (A7A1A2)
6.21	QUASI-PEAK/CARRIER Detector Bd (A7A1A3)
6.22	Log Amplifier Bd (A7A1A4)
6.23	PEN #2 Driver Bd (A7A1A5)
6.24	Detector Logic Bd (A7A1A11)
6.25	Attenuator A Bd (A7A1A10)
6.26	Attenuator B Bd (A7A1A9)
6.27	Attenuator C Bd (A7A1A8)
6.28	Attenuator Display Bd (A1A4)
6.29	Attenuator Drive Bd (A2A19)
6.30	Interconnection Diagram Main Unit
6.31	Sweep Control Bd (A1A5)
6.32	Sweep Bd (A1A6)
6.33	Tuning Regulator Bd (A2A16A2)
6.34	Auto Sweep/Audio Amplifier Bd (A7A1A6)
6.35	Control Section Interconnections
6.36	Frequency Display Assembly (A1A3)
6.37	Band Indicator Display Bd (A1A7) and Band Indicator Drive Bd (A1A8)
6.38	Band Control Bd (A6A3)
6.39	Power Supply Assembly (A6)
6.40	H.V. Connector (A6A4)

TABLE 6-1

REPLACEABLE MODULES, BOARDS, AND ASSEMBLIES

Description	Nomenclature
Coarse Tuning Assembly	A1A1
Low Pass Filter (Sealed)	A1A2
Frequency Display Module	A1A3
Attenuator Display Assembly	A1A4
Sweep Control Board	A1A5
Sweep Board	A1A6
Band Indicator Assembly (2 permanently connected boards)	A1A7/A1A8
Front Panel Meter	A1M1
RF Preselector Assembly (Complete)	A2
RF Band Segment 1	A2A1
RF Band Segment 2	A2A2
RF Band Segment 3	A2A3
RF Band Segment 4	A2A4
RF Band Segment 5	A2A5
RF Band Segment 6	A2A6
RF Band Segment 7	A2A7
RF Band Segment 8	A2A8
RF Band Segment 9	A2A9
RF Band Segment 10	A2A10
RF Band Segment 11 (Sealed)	A2A11
RF Band Segment 12 (Sealed)	A2A12
RF Band Segment 13 (Sealed)	A2A13
RF Band Segment 14 (Sealed)	A2A14
RF Band Segment 15 (Sealed)	A2A15
RF Tuner/Stator Board	A2A16A1
Tuning Regulator Board	A2A16A2
Gear Train Assembly	A2A16A3
LO Amplifier Assembly	A2A16A4
Impulse Calibrator Assembly	A2A17
RF Attenuator Assembly (Sealed)	A2A18

TABLE 6-1 (cont'd)

REPLACEABLE MODULES, BOARDS, AND ASSEMBLIES

Description	Nomenclature
Attenuator Drive Board	A2A19
IF Amplifier/Discriminator Module	A3
1.6MHz IF Amplifier—9kHz BW Board	A3A1
8.7MHz IF Amplifier—120kHz BW Board	A3A2
Discriminator Board	A3A3
Linear Detector Module	A4
Linear Detector Board	A4A1
Mixer Module	A5
Mixer Board	A5A1
Power Supply Assembly (Semi-Permanent Assembly)	A6
Power Supply Inner Module	A6A1
Power Supply Board	A6A1A1
IF/MIXER Control Board	A6A2
Band Control Board	A6A3
High Voltage Converter Module (Sealed)	A6A4
Card Rack Assembly	A7A1
RMS Detector Board	A7A1A1
PEAK Detector Board	A7A1A2
QUASI-PEAK/CARRIER Board	A7A1A3
Log Amplifier Board	A7A1A4
PEN #2 Driver Board	A7A1A5
Auto Sweep/Audio Amplifier Board	A7A1A6
Attenuator Control "C" Board	A7A1A8
Attenuator Control "B" Board	A7A1A9
Attenuator Control "A" Board	A7A1A10
Detector Logic Board	A7A1A11
Battery Charger and Low Voltage Cutoff Board	A7A1A12
Battery Pack	A9

TABLE 6-2

RECOMMENDED SPARE PARTS LIST FOR MODEL CPR-25 INTERFERENCE ANALYZER

Description	Recommended Quantity 1 Set	 10 Sets	Part No.
Quad Input NOR	1	2	4001
4 Bit Binary Full Adder	1	2	4008
Triple 3 Input NAND	1	2	4023
HEX Inverting Buffer	1	2	4049
BCD to 7 Segment Latch/Decoder/Driver	0	1	F4511
4 Bit Magnitude Comparator	0	1	F40085
4 Bit UP/DOWN Decade Counter	0	1	40192
Quad 2 Input AND	1	2	34081
Quad Low to High Voltage Translator	0	1	34104
Display Driver	0	1	CD4054A
7 Segment Decoder/Driver	0	1	CD4055A
3½ Digit Liquid Crystal Display	0	1	FE0201
6 Digit Liquid Crystal Display	0	1	IEE5663
RMS Converter	0	1	AD536J
LOGGING Amplifier	0	1	ICL8048CCDE
Operational Amplifier	1	2	uA7A1
Operational Amplifier	1	2	BB3521H
Operational Amplifier	1	2	BB3522
Operational Amplifier	1	2	LM210/LM210H
Operational Amplifier	1	2	LM218
Dual Operational Amplifier	1	3	LM1458
Differential Amplifier	1	2	CA3028
Dual Differential Amplifier	1	2	CA3026
High Gain Amplifier	1	2	GPD-461
Double-Balanced Modulator/Demodulator	0	1	uA796
Voltage Regulator	1	2	uA723DM
4 Terminal Voltage Regulator	1	2	uA78G
3 Terminal Positive Voltage Regulator	1	2	uA7805UC
+12VDC Voltage Regulator	1	3	LAS15u
-6VDC Voltage Regulator	1	3	LAS18U
Transistor-NPN-Darlington	1	3	PMD-12K
Transistor-pnp-Darlington	1	3	PMD-13K
Transistor-NPN-Darlington	1	2	RCA-120

TABLE 6-2 (cont'd)

RECOMMENDED SPARE PARTS LIST FOR MODEL CPR-25 INTERFERENCE ANALYZER

Description	Recommended Quantity 1 Set	 10 Sets	Part No.
Transistor-NPN-Darlington	1	2	2N5308
NPN Darlington Array	1	2	ULN-2001A
N Channel FET	1	2	2N5457
N Channel FET	1	2	2N4416
Dual N Channel FET	1	2	3N200
FET Switch Array	0	1	AH5012
Transistor NPN	2	6	2N3690
Transistor PNP	2	4	2N4250
Transistor NPN	1	2	2N5307
Transistor NPN	1	2	2N2484
Transistor NPN	1	2	2N2222
Transistor NPN	1	2	2N918
Transistor NPN	0	1	2N915
Transistor PNP	1	2	2N2904
Transistor NPN	1	2	2N3566
Transistor NPN	1	2	2N2218
Transistor PNP	1	2	2N4888
Transistor NPN	1	2	SE3005
Dual NPN Transistor	1	2	2N2920
Diode	2	10	IN3064
Diode-Germanium	1	3	IN270
Diode	1	2	FD300
Diode	1	1	2A100
Diode	1	2	2A400
Diode	1	2	IN5059
Diode Zener 3.5V	1	2	GEZD3.5
Diode Zener 8.2V	1	2	IN756
Diode Zener 12V	1	2	IN759
Diode Zener 24V	1	2	IN1780
Diode Zener 110V	1	2	IN986B
Varactor (47PF)	1	4	MC105B
Varactor (235PF)	1	2	VS821
Relay	1	3	712TN26

TABLE 6-3

ACCESSORY LIST

Item	Description	Model
1	Interference Analyzer, 10kHz–1GHz, including: AC Power Cord PCD-25, Adapter Brackets ABM-25, Coaxial Cable Model CAC-25 and Instruction Manual	CPR-25
2	Carrying Case/Shipping Container	CCC-25
3	Remotely Switchable Loop Antenna, 10kHz to 30MHz	ALR-25
4	Remotely Switchable Vertical 41" Antenna, 10kHz to 30MHz	RVR-25
5	Broadband Dipole Antenna and Mount, 20MHz to 200MHz	BDA-25
6	Biconical Antenna, 20–200MHz	BIA-25
7	Low Frequency Antenna Accessory Case-For Transporting Loop Antenna, 41" Vertical Antenna, Broadband Dipole and various small accessories.	LVC-25
8	Log Conical Spiral Antenna, 200MHz to 1000MHz	LCA-25
9	Conical Antenna Carrying Case for LCA-25	LCC-25
10	Clamp-on Probe, 10kHz to 110MHz	PCL-25
11	Magnetic Field Probe, 10kHz to 520kHz	MFA-25
12	Magnetic Field Probe, 480kHz to 25MHz	MFB-25
13	Magnetic Field Probe, 22MHz to 230MHz	MFC-25
14	Electro-Static Field Probe, 10kHz to 1000MHz	EFP-25
15	Counterpoise, 2'X2' (for vertical antennas)	GPA-25
16	Earphones, 600 ohms.	EEM-25
17	Remote Meter with 25 ft. cable	RIM-25R
18	Coaxial Cable, 25 foot 50 ohm TNC	CAC-25
19	Extension Board	ECB-25C
20	Alignment Tool Kit	ATK-25
21	Audio Amplifier and Speaker	AA-25
22	Tripod (Rugged) and Tripod Bag	TRP-25
23	Mast Sections (2)	MSA-25
24	Nickel Cadmium Battery Pack	BAT-25C
25	Extra Adapter Brackets — pair for 19" rack mounting	ABM-25
26	Extra AC Power Cord	PCD-25
27	Extra Instruction Manual	—
28	Calibrated Impulse Generator — variable rep rate between 1 and 100Hz (manual included).	CIG-25
29	Tunable Rejection Filters	
	14kHz to 220kHz	TRF-11
	220kHz t0 3500kHz	TRF-12
	3.5MHz to 14MHz	TRF-13
	14MHz to 110MHz	TRF-14
	110MHz to 1000MHz	TRF-15

TABLE 6-3 (cont'd)

ACCESSORY LIST

Item	Description	Model
30	Complete Set: Tunable Rejection Filters, 14 kHz to 1000MHz	TRF-1115
31	Instrument Carrying Case for one TRF Tilter	ICC-15
32	Standard Accessory Kit, 10kHz–1GHz Including: ALR-25 Loop Antenna, RVR-25 Vertical 41 in. Antenna, LVC-25 and LAC-25 Antenna Accessory Cases, BDA-25 Dipole Antenna, LCA-25 Log Conical Antenna, LCC-25 Log Conical Antenna Case, PCL-25 Current Probe, MFA-25, MFB-25 and MFC-25 Magnetic Field Probes, EFP-25 Electrostatic Probe, TRP-25 Tripod (rugged) and bag, GPA-25 Counterpoise, (for RVR-25 Vertical Antenna), AMT-25 Antenna Mount and MSA-25 Mast Sections (2), ICC-25 Instrument Carrying Case, ACC-25B Antenna Control Cable, CAC-25 Coaxial Cable, 25 ft. & manuals	AAK-25A
33	Standard Accessory Kit for FCC Testing, 300–1000MHz including: BIA-25 Biconical Antenna, LPA-25 Log Periodic Antenna, TDA-25 Tunable Dipole Antenna, 30–200MHz, TDS-25 Tunable Dipole Set, 200–1000MHz, EFP-25 Electrostatic Probe, TRP-25 Tripod, rugged with bag	AAK-25F
34	Electro-Scan Programmer for external control of the CPR-25 with SU-125 Antenna Switching Unit	ESC-125C
35	11" X 17" Dual-Pen X-Y Plotter with interconnecting cable and Instruction Manual	EXY-250C
36	Extra X-Y Plotter Interconnecting Cable to CPR-25	XYC-25
37	Automated EMI System (CISPR/FCC/VDE) 10kHz–1GHz 1. CPR-25 Interference Analyzer 10kHz–1GHz 2. ESC-125C Programmer 3. EXY-250C Plotter, X-Y – 11" X 17" (Dual-Pen) 4. CIG-25 Calibrated Impulse Generator 5. SPK-100 Speaker Panel 6. SU-125 Antenna Switching Unit 7. Vertical Console with writing surface, cables & slides 8. Manuals (1 set)	FSS-25CPR
38	Spectrum Display Unit	SPD-110
39	Spectrum Display Storage Unit	SPD-11

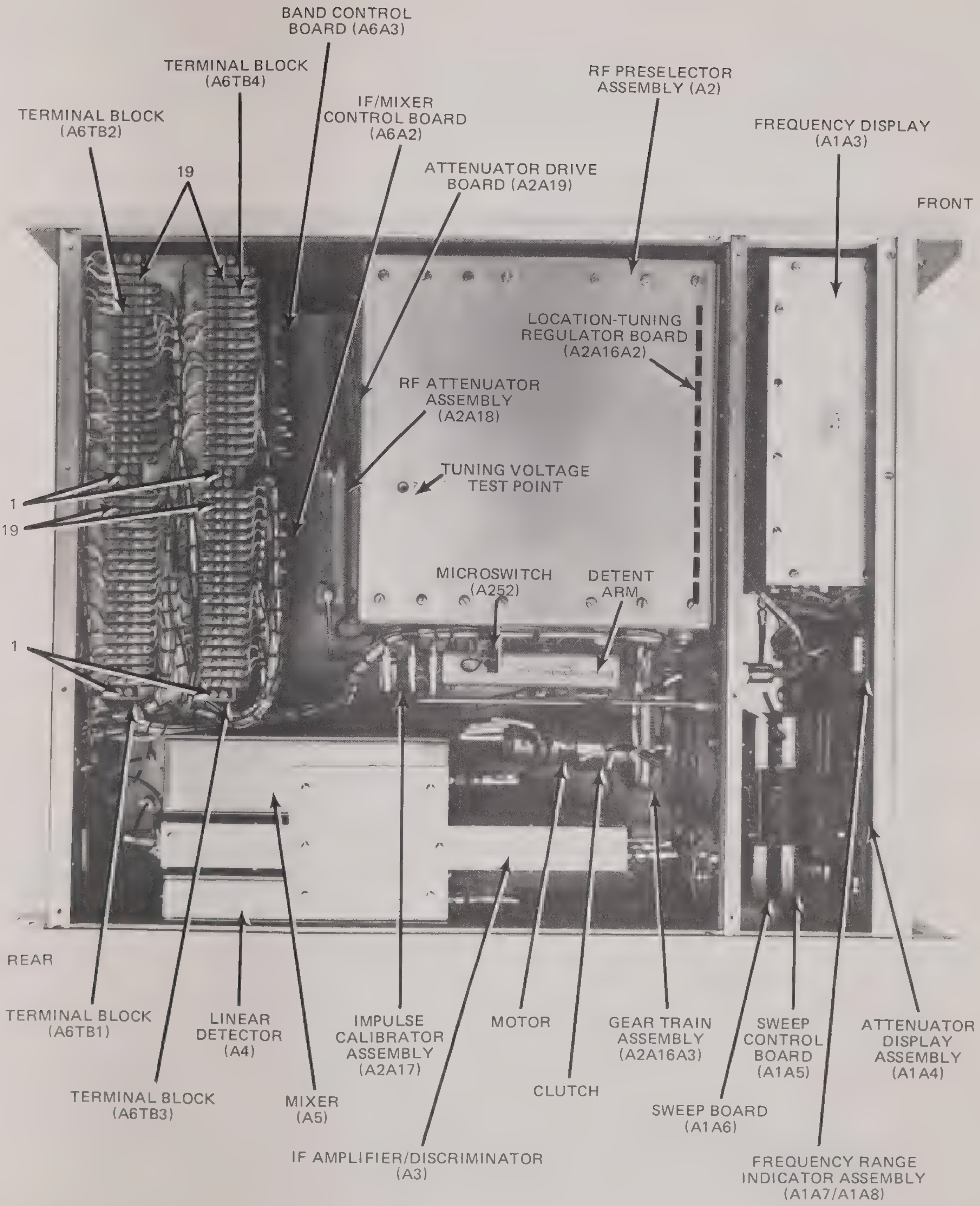

BAND CONTROL BOARD (A6A3)
TERMINAL BLOCK (A6TB4)
RF PRESELECTOR ASSEMBLY (A2)
IF/MIXER CONTROL BOARD (A6A2)
TERMINAL BLOCK (A6TB2)
FREQUENCY DISPLAY (A1A3)
19
ATTENUATOR DRIVE BOARD (A2A19)
FRONT
LOCATION-TUNING REGULATOR BOARD (A2A16A2)
RF ATTENUATOR ASSEMBLY (A2A18)
TUNING VOLTAGE TEST POINT
1
19
MICROSWITCH (A2S2)
DETENT ARM
1
REAR
TERMINAL BLOCK (A6TB1)
LINEAR DETECTOR (A4)
IMPULSE CALIBRATOR ASSEMBLY (A2A17)
MOTOR
GEAR TRAIN ASSEMBLY (A2A16A3)
SWEEP CONTROL BOARD (A1A5)
ATTENUATOR DISPLAY ASSEMBLY (A1A4)
TERMINAL BLOCK (A6TB3)
MIXER (A5)
CLUTCH
SWEEP BOARD (A1A6)
IF AMPLIFIER/DISCRIMINATOR (A3)
FREQUENCY RANGE INDICATOR ASSEMBLY (A1A7/A1A8)

Figure 6.1A

Location Guide Top View

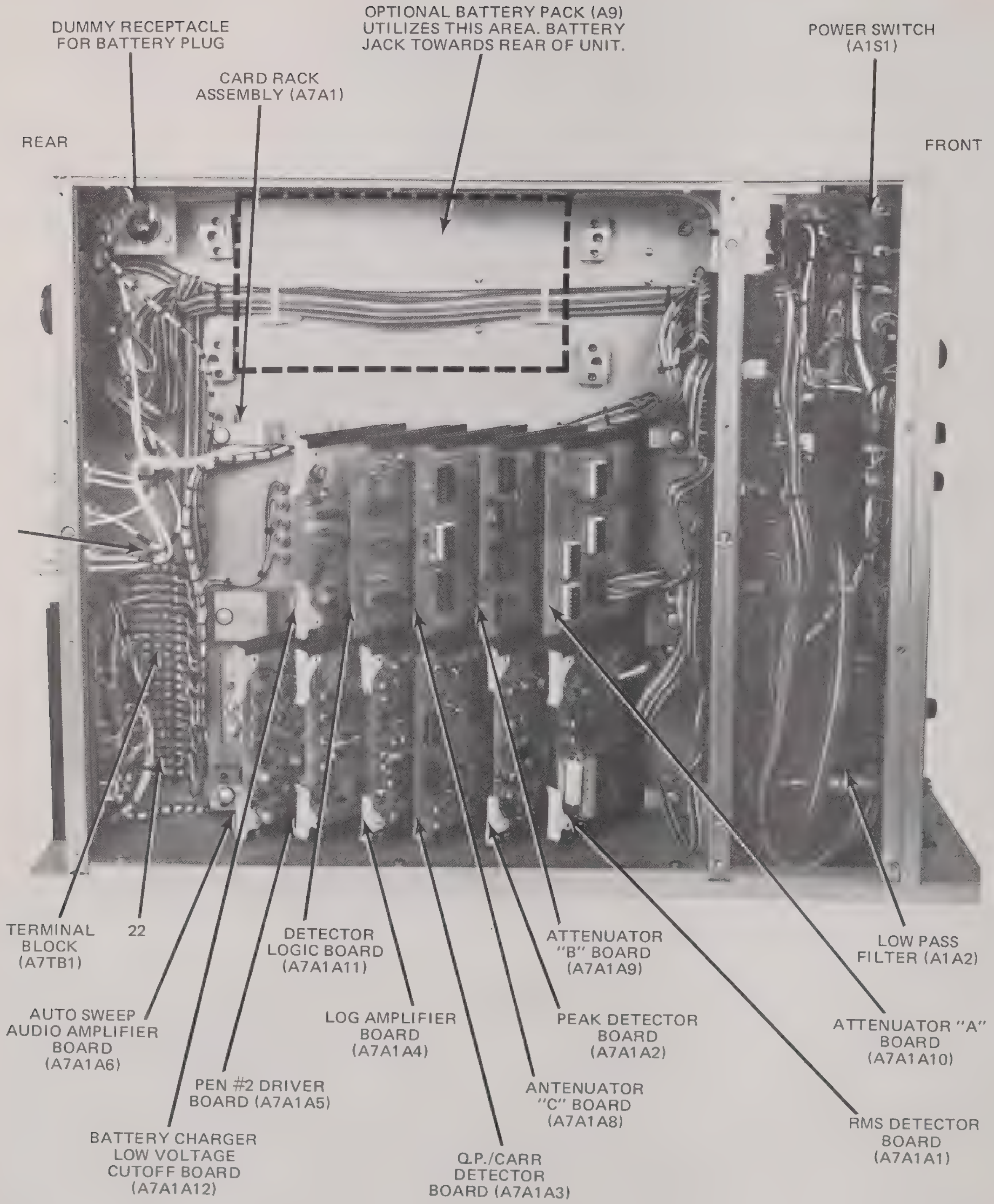

DUMMY RECEPTACLE FOR BATTERY PLUG
OPTIONAL BATTERY PACK (A9) UTILIZES THIS AREA. BATTERY JACK TOWARDS REAR OF UNIT.
POWER SWITCH (A1S1)
CARD RACK ASSEMBLY (A7A1)
REAR
FRONT
TERMINAL BLOCK (A7TB1)
22
DETECTOR LOGIC BOARD (A7A1A11)
ATTENUATOR "B" BOARD (A7A1A9)
LOW PASS FILTER (A1A2)
AUTO SWEEP AUDIO AMPLIFIER BOARD (A7A1A6)
LOG AMPLIFIER BOARD (A7A1A4)
PEAK DETECTOR BOARD (A7A1A2)
ATTENUATOR "A" BOARD (A7A1A10)
PEN #2 DRIVER BOARD (A7A1A5)
ANTENUATOR "C" BOARD (A7A1A8)
RMS DETECTOR BOARD (A7A1A1)
BATTERY CHARGER LOW VOLTAGE CUTOFF BOARD (A7A1A12)
Q.P./CARR DETECTOR BOARD (A7A1A3)

Figure 6.1B

Location Guide Bottom View

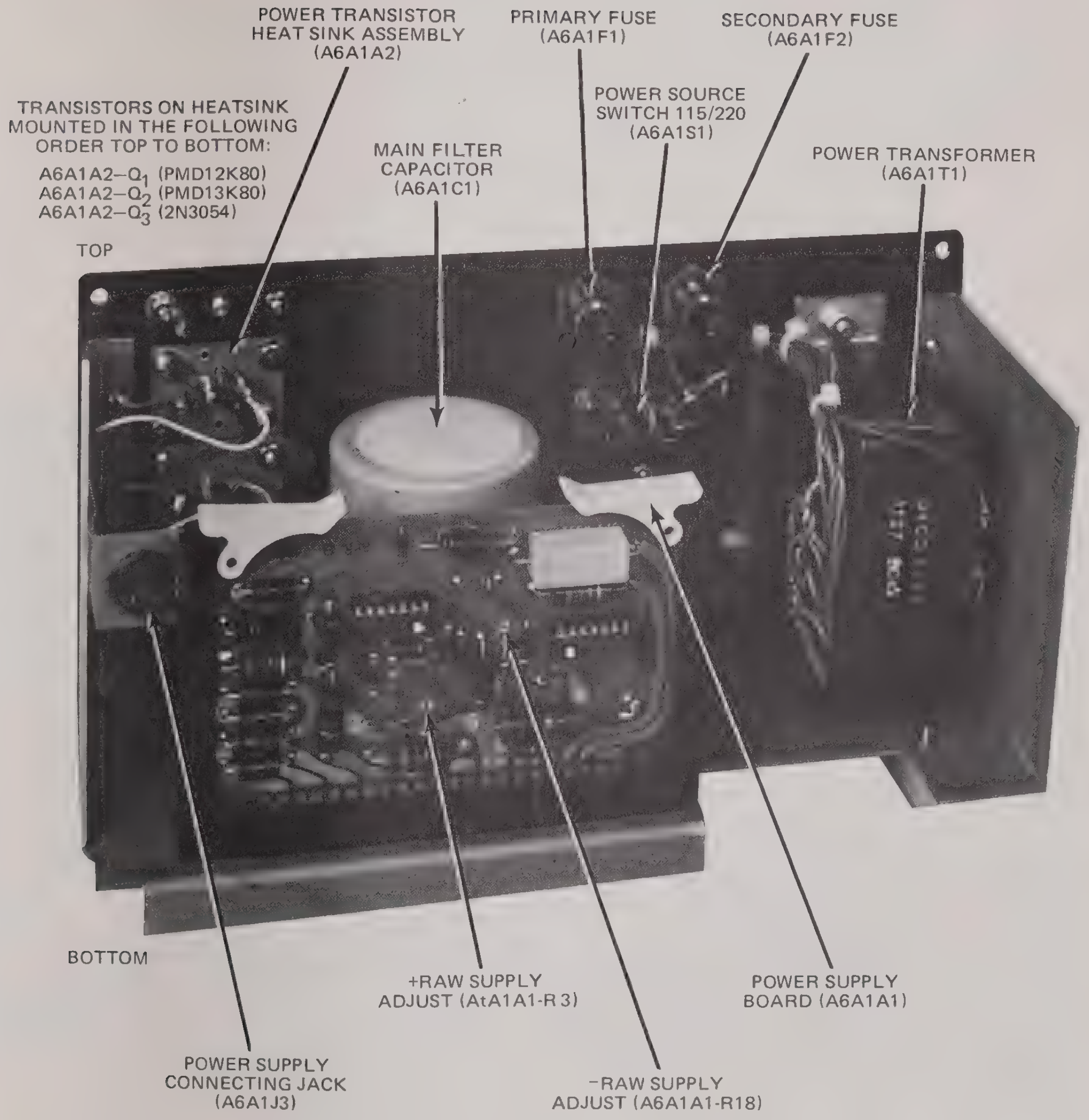

POWER TRANSISTOR HEAT SINK ASSEMBLY (A6A1A2)
PRIMARY FUSE (A6A1F1)
SECONDARY FUSE (A6A1F2)
POWER SOURCE SWITCH 115/220 (A6A1S1)
TRANSISTORS ON HEATSINK MOUNTED IN THE FOLLOWING ORDER TOP TO BOTTOM:
A6A1A2–Q_1 (PMD12K80)
A6A1A2–Q_2 (PMD13K80)
A6A1A2–Q_3 (2N3054)
MAIN FILTER CAPACITOR (A6A1C1)
POWER TRANSFORMER (A6A1T1)
TOP
BOTTOM
+RAW SUPPLY ADJUST (AtA1A1-R 3)
POWER SUPPLY BOARD (A6A1A1)
POWER SUPPLY CONNECTING JACK (A6A1J3)
–RAW SUPPLY ADJUST (A6A1A1-R18)

Figure 6.1C

Location Guide Power Supply Inner Module (A6A1)

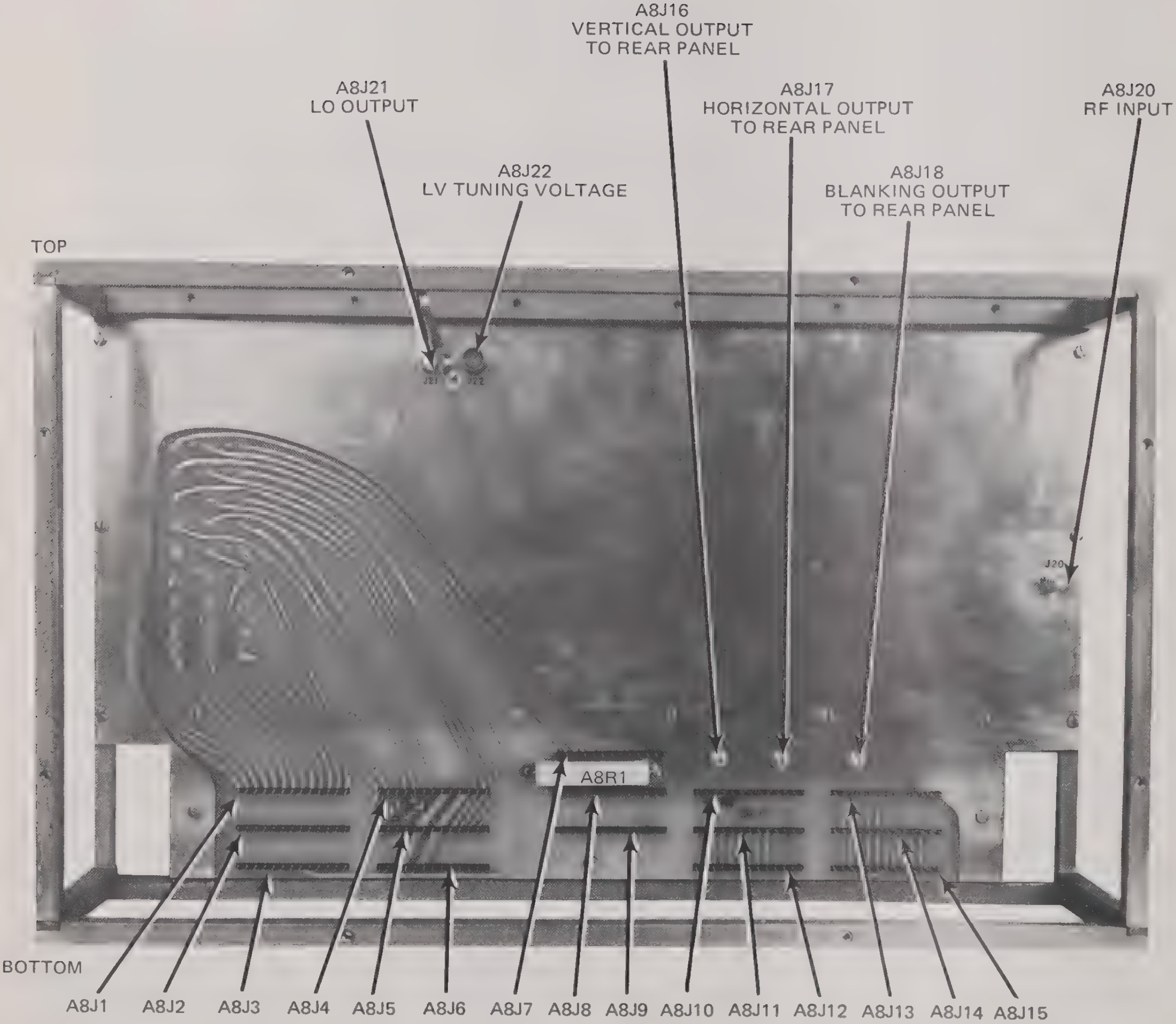
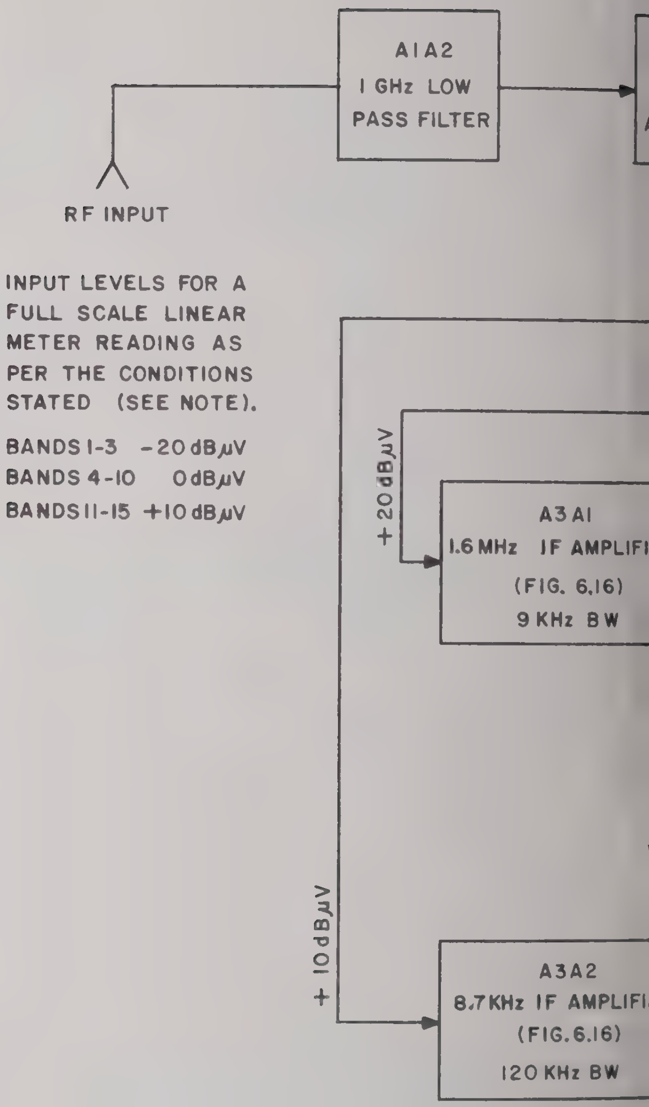


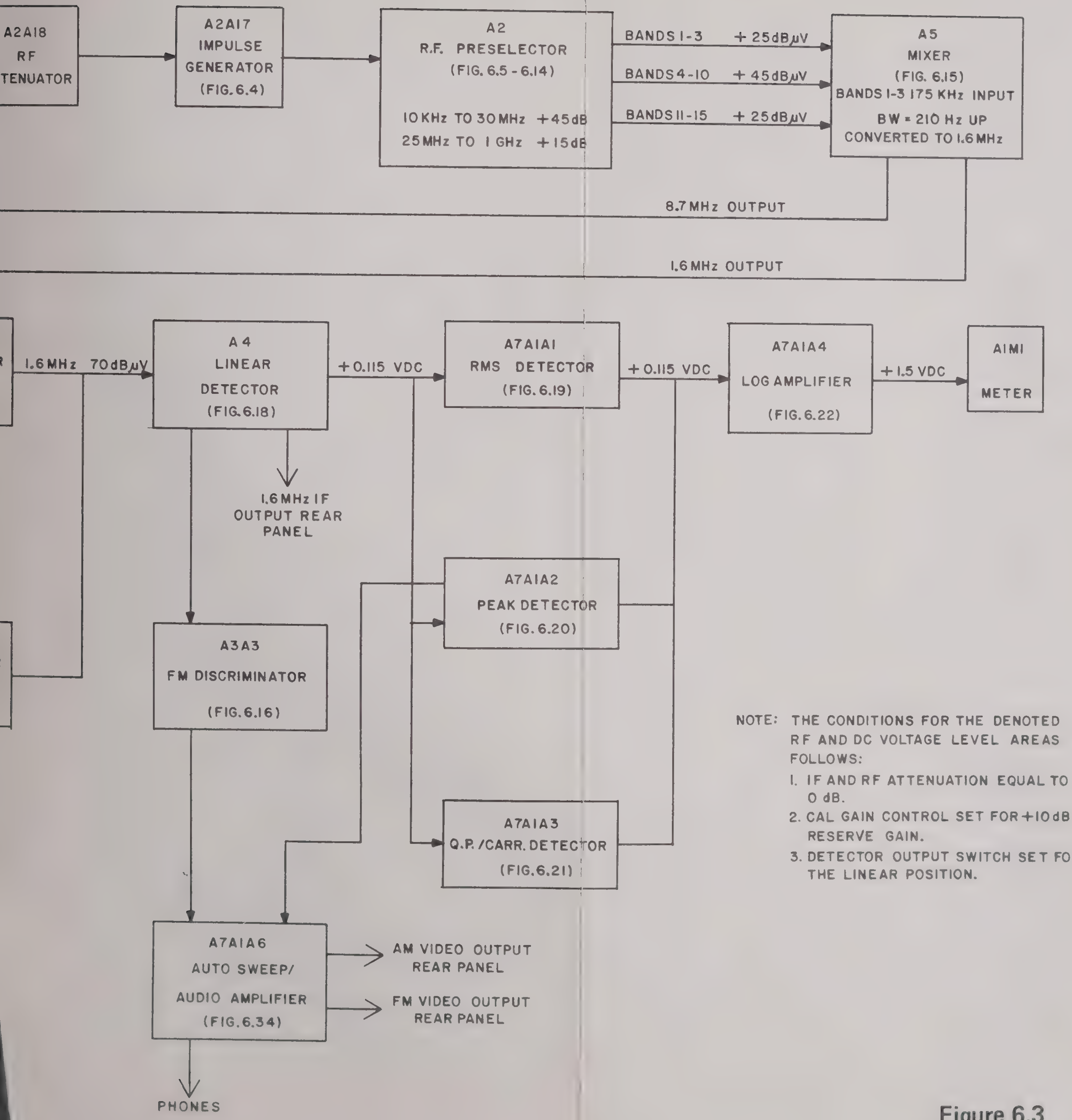
Figure 6.2

Location Guide Front Bulkhead



INPUT LEVELS FOR A FULL SCALE LINEAR METER READING AS PER THE CONDITIONS STATED (SEE NOTE).

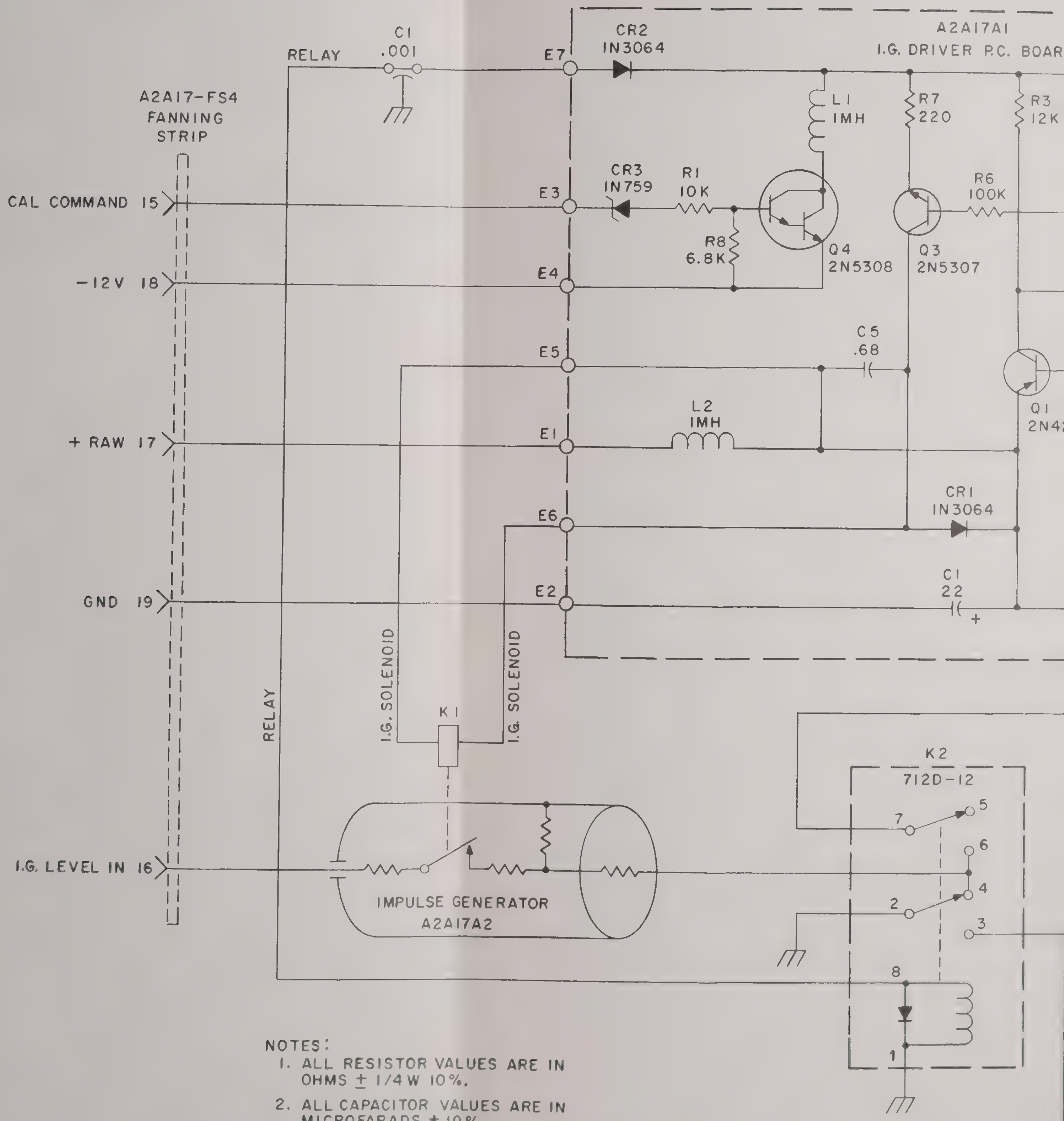
BANDS 1-3 −20 dBμV
BANDS 4-10 0 dBμV
BANDS 11-15 +10 dBμV



NOTE: THE CONDITIONS FOR THE DENOTED RF AND DC VOLTAGE LEVEL AREAS FOLLOWS:

1. IF AND RF ATTENUATION EQUAL TO 0 dB.
2. CAL GAIN CONTROL SET FOR +10 dB RESERVE GAIN.
3. DETECTOR OUTPUT SWITCH SET FOR THE LINEAR POSITION.

Figure 6.3
Signal Flow Chart



NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS ± 1/4 W 10%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%.

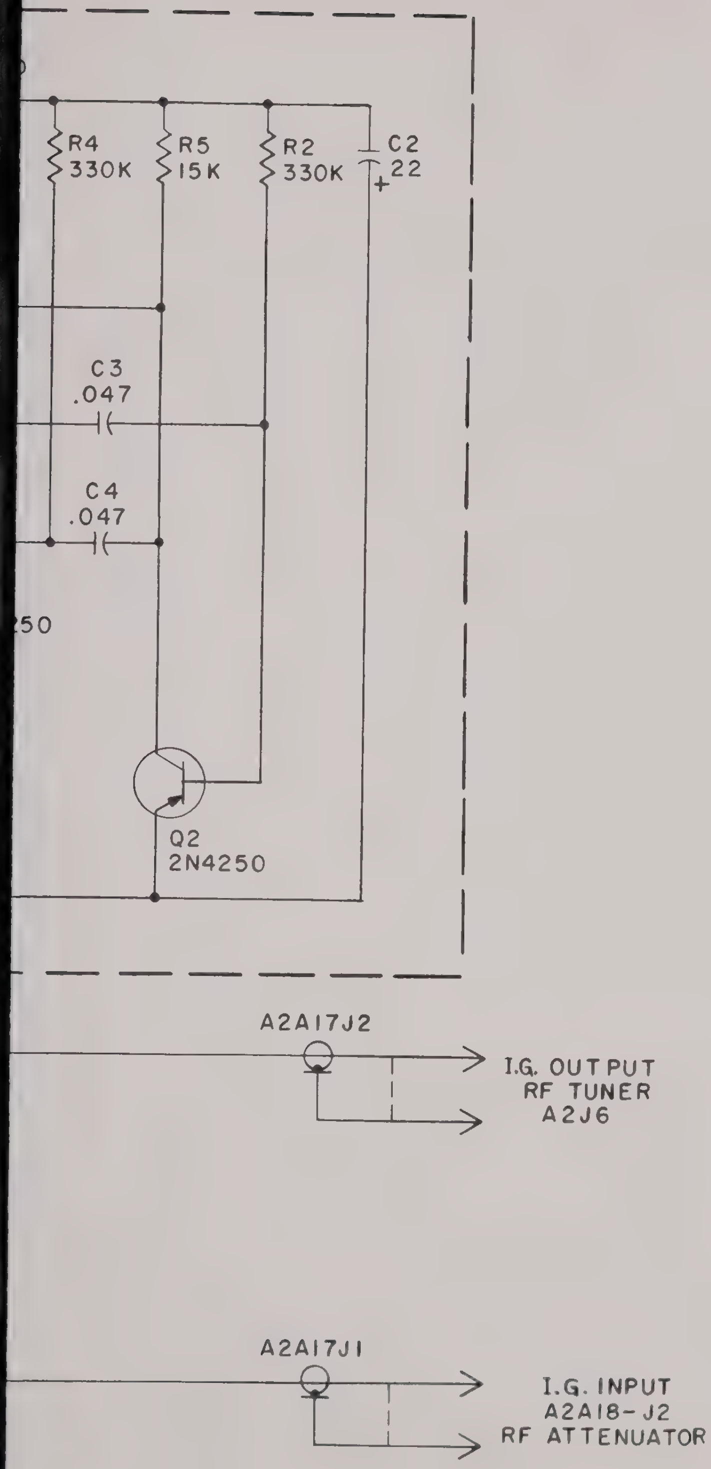
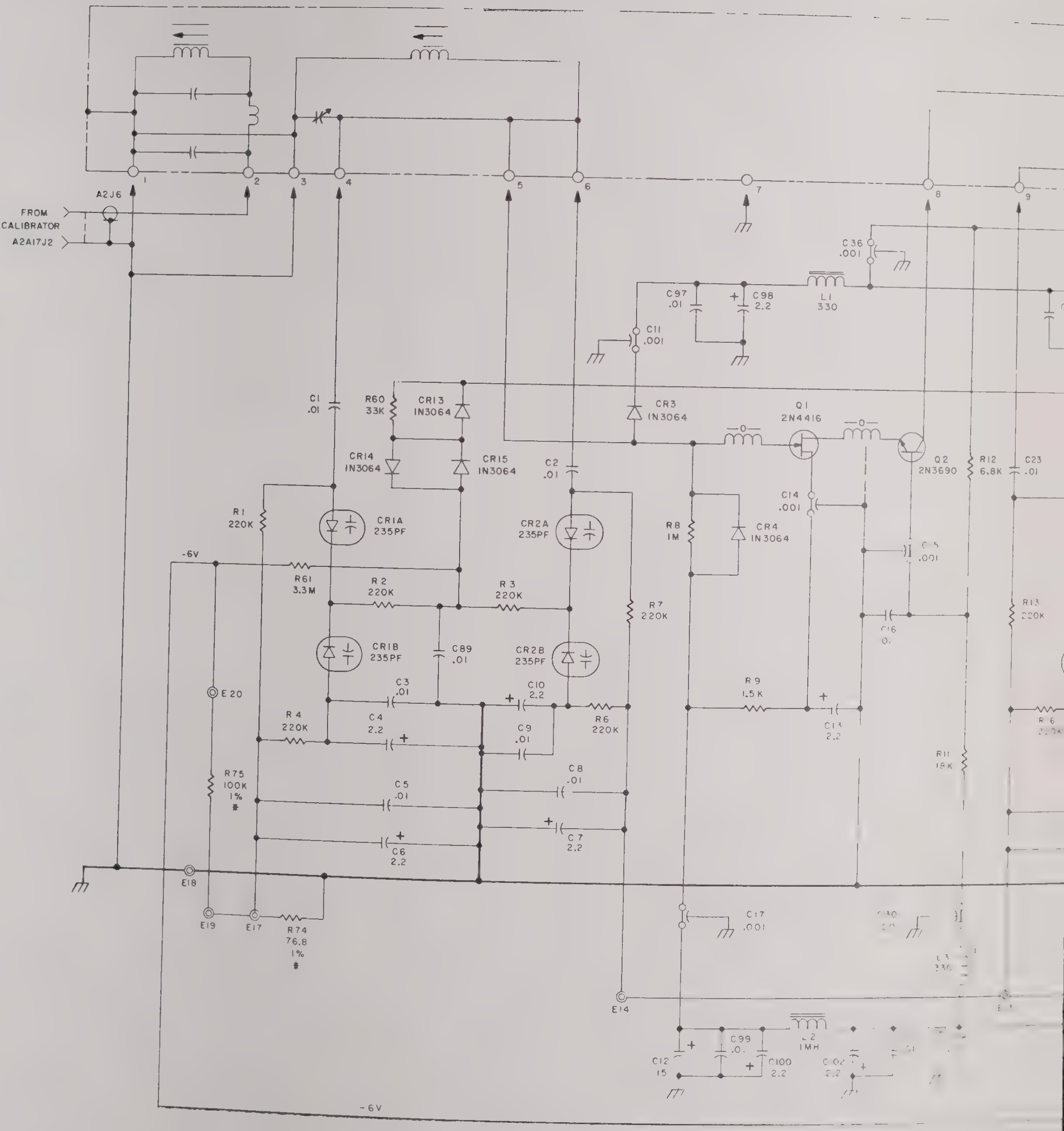
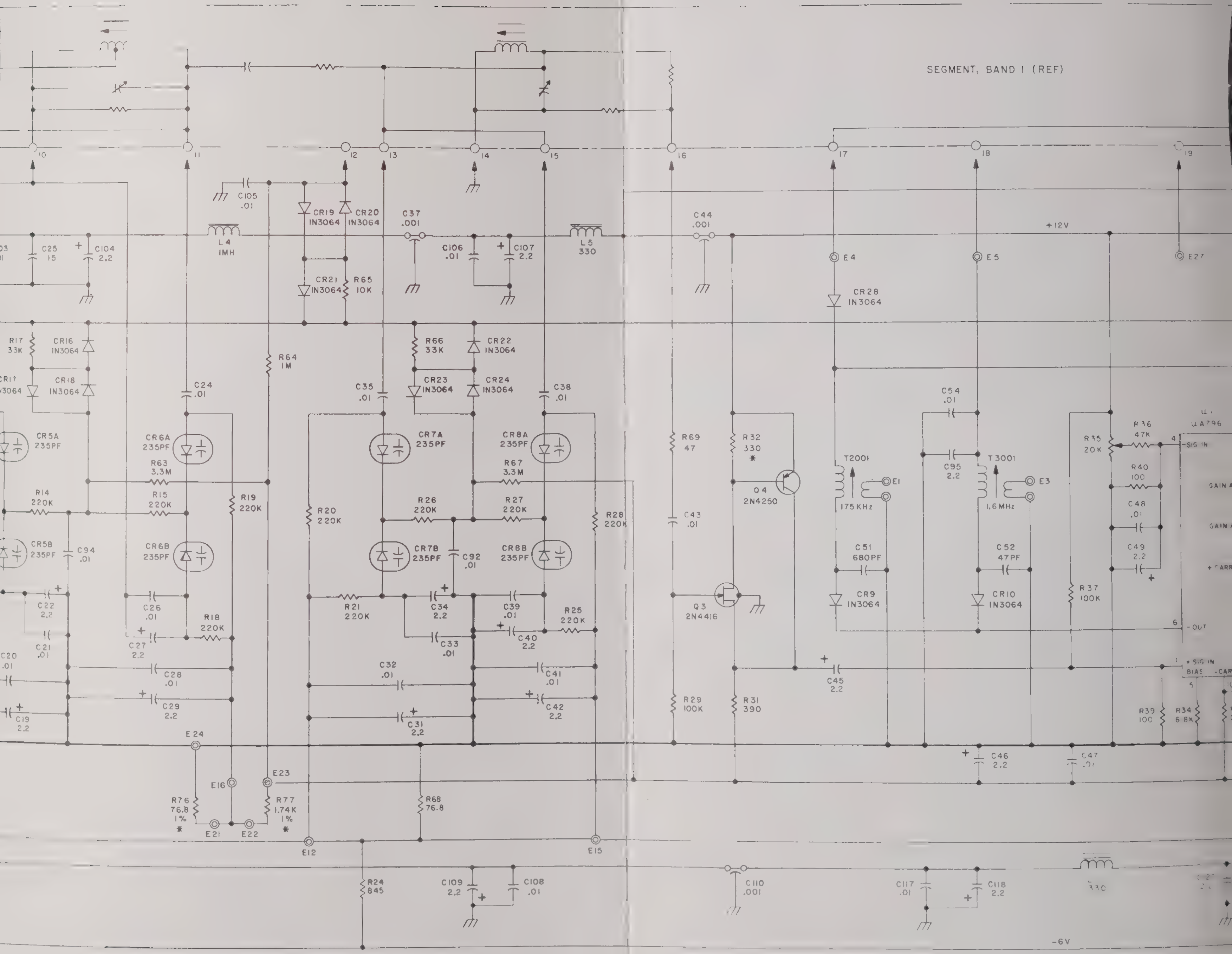
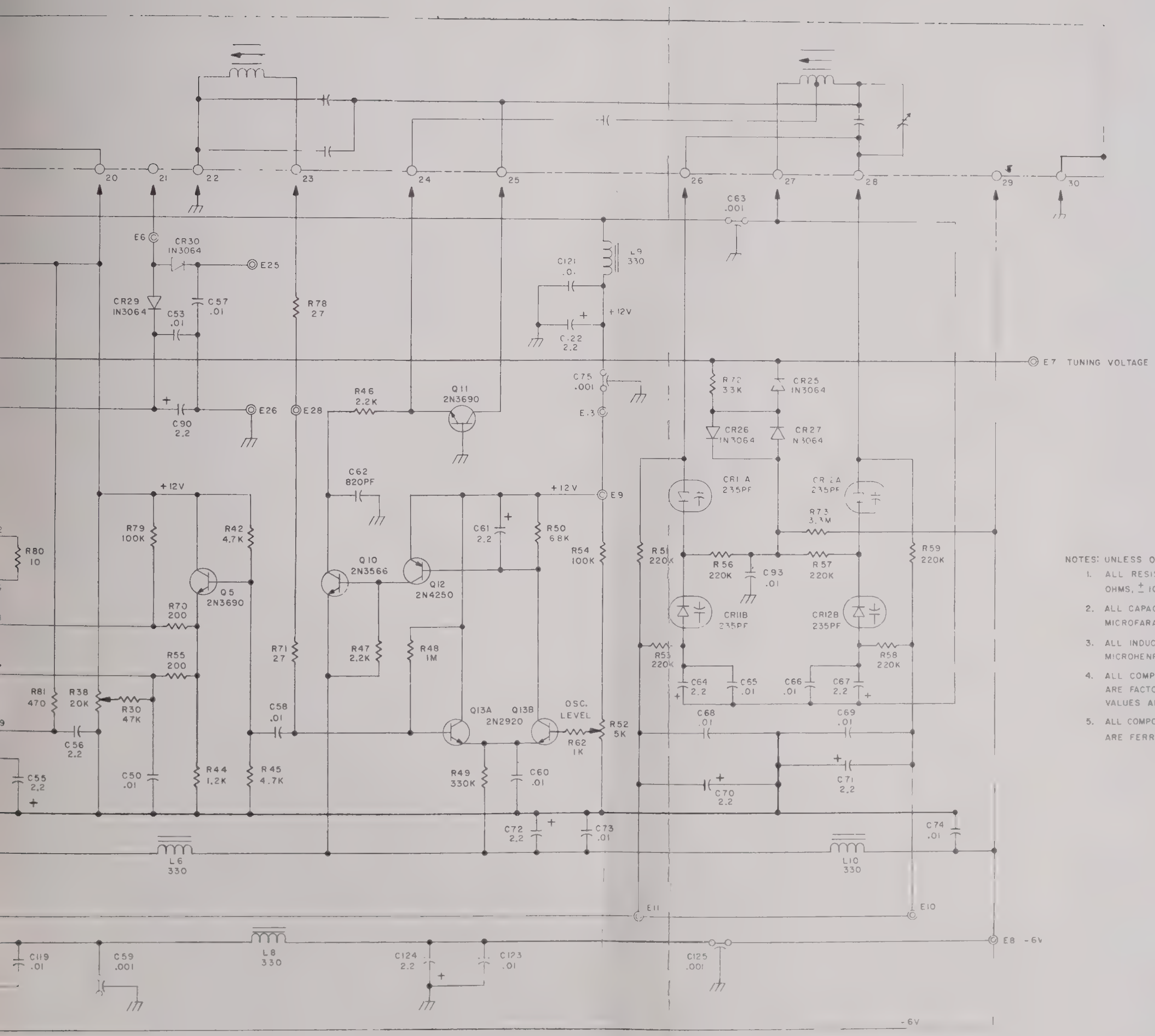


Fig. 6.4
Calibrator (A2A17)


FROM
CALIBRATOR
A2A17J2
A2J6
1
2
3
4
5
6
7
8
9
C36
.001
C97
.01
C98
2.2
L1
330
C11
.001
C1
.01
R60
33K
CR13
IN3064
CR3
IN3064
Q1
2N4416
CR14
IN3064
CR15
IN3064
C2
.01
Q2
2N3690
R12
6.8K
C23
.01
R1
220K
CR1A
235PF
CR2A
235PF
C14
.001
R8
1M
CR4
IN3064
C15
.001
-6V
R61
3.3M
R2
220K
R3
220K
R7
220K
R13
220K
C16
0.
CR1B
235PF
C89
.01
CR2B
235PF
E20
C3
.01
C10
2.2
R9
1.5K
R4
220K
C4
2.2
R6
220K
C13
2.2
C9
.01
R16
R11
18K
C8
.01
R75
100K
1%
*
C5
.01
C7
2.2
C6
2.2
E18
E19
E17
R74
76.8
1%
*
C17
.001
C30
L3
330
E14
C99
.01
C12
15
C100
2.2
L2
1MH
C102
2.2
-6V

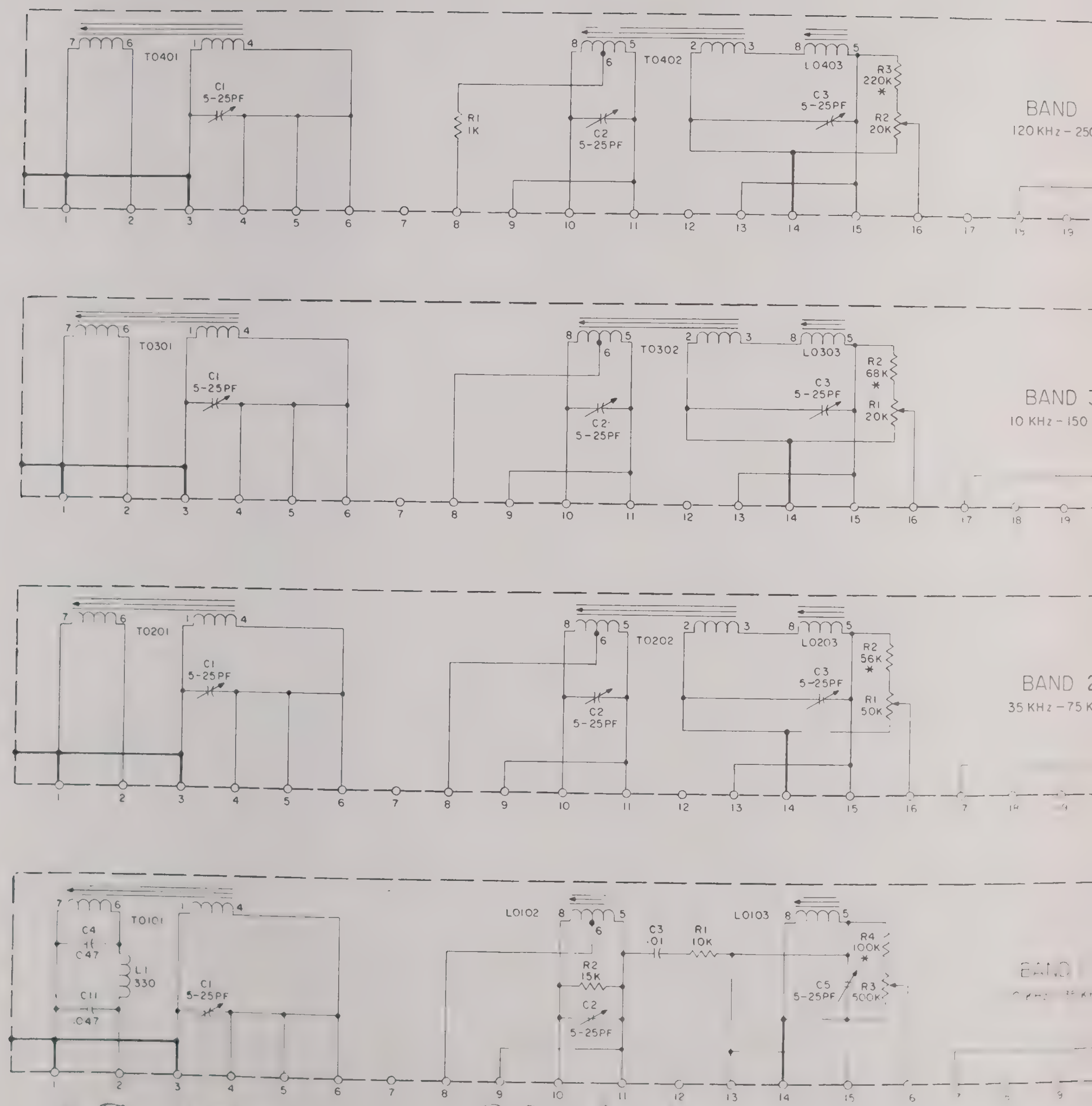

SEGMENT, BAND I (REF)
10
11
12
13
14
15
16
17
18
19
C105
.01
CR19
IN3064
CR20
IN3064
C37
.001
C44
.001
+12V
C25
15
C104
2.2
L4
1MH
C106
.01
C107
2.2
L5
330
E4
E5
E27
CR21
IN3064
R65
10K
CR28
IN3064
R17
33K
CR16
IN3064
CR17
IN3064
CR18
IN3064
R64
1M
C24
.01
R66
33K
CR22
IN3064
CR23
IN3064
CR24
IN3064
C35
.01
C38
.01
C54
.01
CR5A
235PF
CR6A
235PF
CR7A
235PF
CR8A
235PF
R69
47
R32
330
*
T2001
C95
2.2
T3001
R36
47K
R35
20K
U
uA796
4
-SIG IN
R63
3.3M
R67
3.3M
Q4
2N4250
E1
E3
R40
100
GAIN A
R14
220K
R15
220K
R19
220K
R26
220K
R27
220K
R20
220K
R28
220K
175KHz
1.6MHz
C43
.01
C48
.01
GAIN A
CR5B
235PF
C94
.01
CR6B
235PF
CR7B
235PF
C92
.01
CR8B
235PF
C51
680PF
C52
47PF
C49
2.2
+CARR
C22
2.2
C26
.01
R21
220K
C34
2.2
C39
.01
R25
220K
Q3
2N4416
CR9
IN3064
CR10
IN3064
R37
100K
C21
.01
C20
.01
R18
220K
C27
2.2
C33
.01
C40
2.2
6
-OUT
C28
.01
C32
.01
C41
.01
C45
2.2
+SIG IN
BIAS
-CAR
5
C19
2.2
C29
2.2
C42
2.2
C31
2.2
R29
100K
R31
390
R39
100
R34
6.8K
E24
C46
2.2
C47
.01
E16
E23
R76
76.8
1%
*
R77
1.74K
1%
*
R68
76.8
E21
E22
E12
E15
R24
845
C109
2.2
C108
.01
C110
.001
C117
.01
C118
2.2
330
-6V



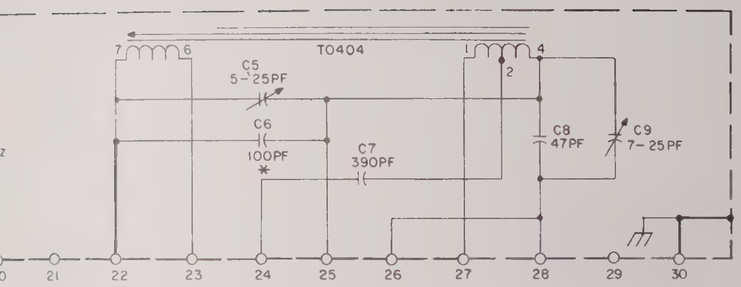
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, ± 10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. ALL COMPONENTS MARKED ● ARE FACTORY ADJUSTED, TYPICAL VALUES ARE SHOWN.
5. ALL COMPONENTS MARKED ─൱─ ARE FERRITE BEADS

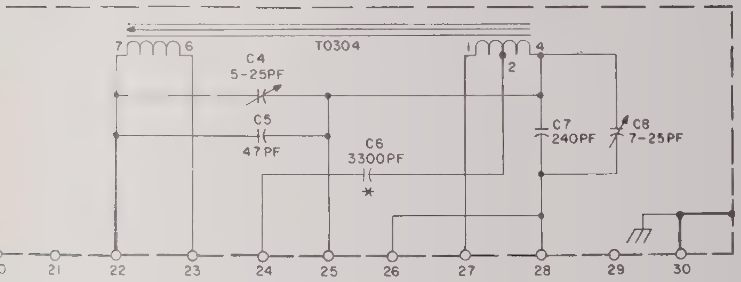
Figure 6.5
RF Tuner/Stator Bd
(A2A16A1)



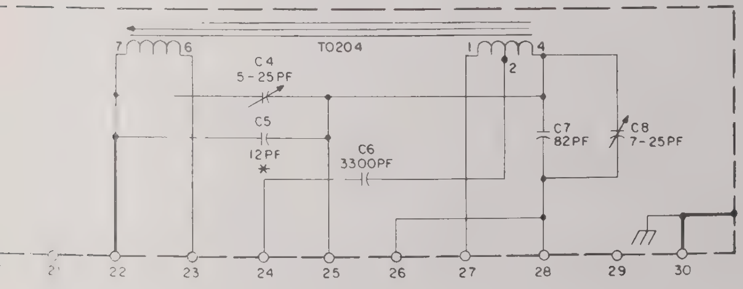
R.F INPUT R.F. Ampl.



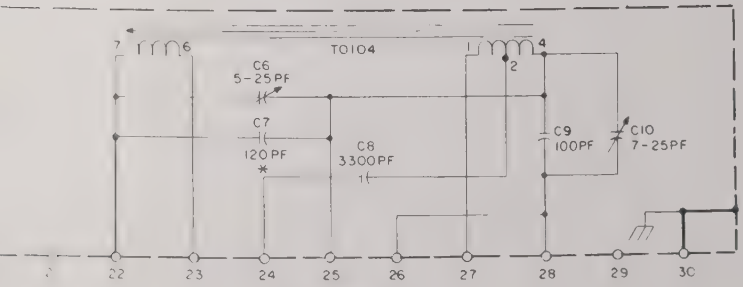
T0404
7
6
1
4
2
C5
5-25PF
C6
100PF
*
C7
390PF
C8
47PF
C9
7-25PF
21
22
23
24
25
26
27
28
29
30



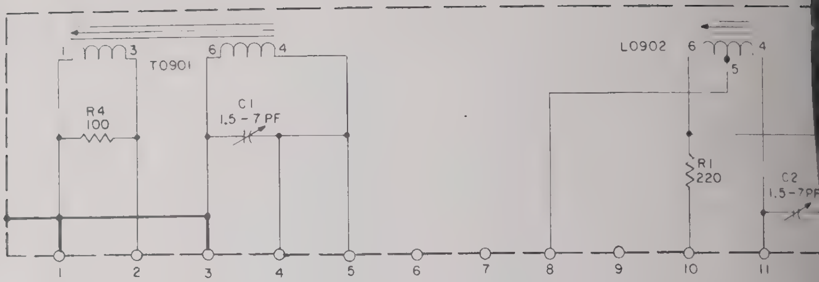
T0304
7
6
1
4
2
C4
5-25PF
C5
47PF
C6
3300PF
*
C7
240PF
C8
7-25PF
21
22
23
24
25
26
27
28
29
30



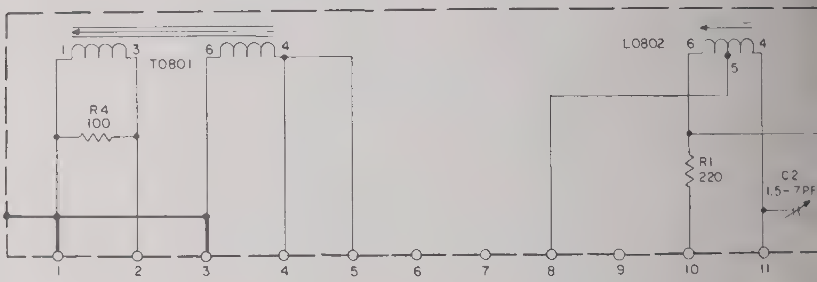
T0204
7
6
1
4
2
C4
5-25PF
C5
12PF
*
C6
3300PF
C7
82PF
C8
7-25PF
22
23
24
25
26
27
28
29
30



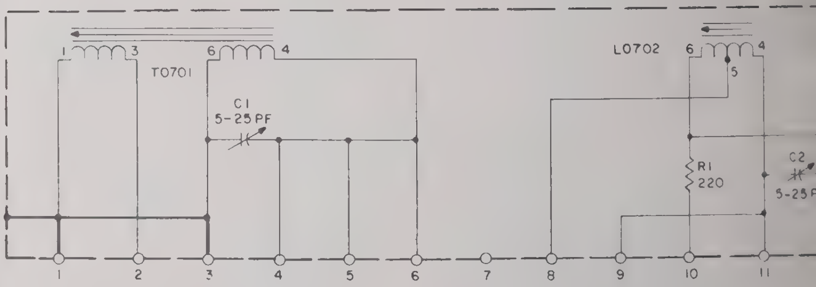
T0104
7
6
1
4
2
C6
5-25PF
C7
120PF
*
C8
3300PF
C9
100PF
C10
7-25PF
22
23
24
25
26
27
28
29
30



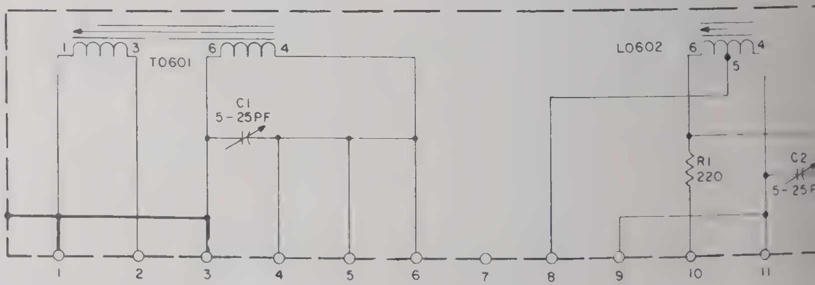
T0901
R4
C1
1.5-7PF
L0902
R1
C2
1.5-7PF



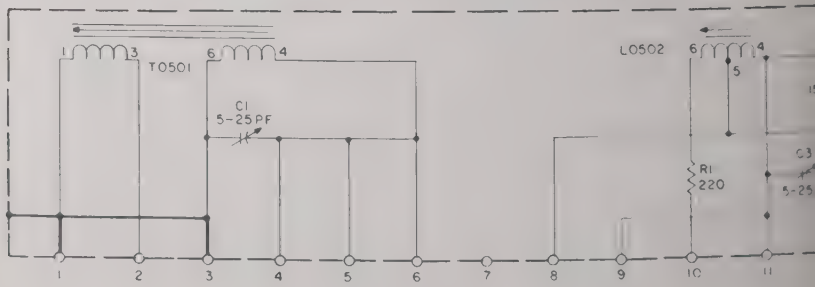
T0801
R4
L0802
R1
C2
1.5-7PF



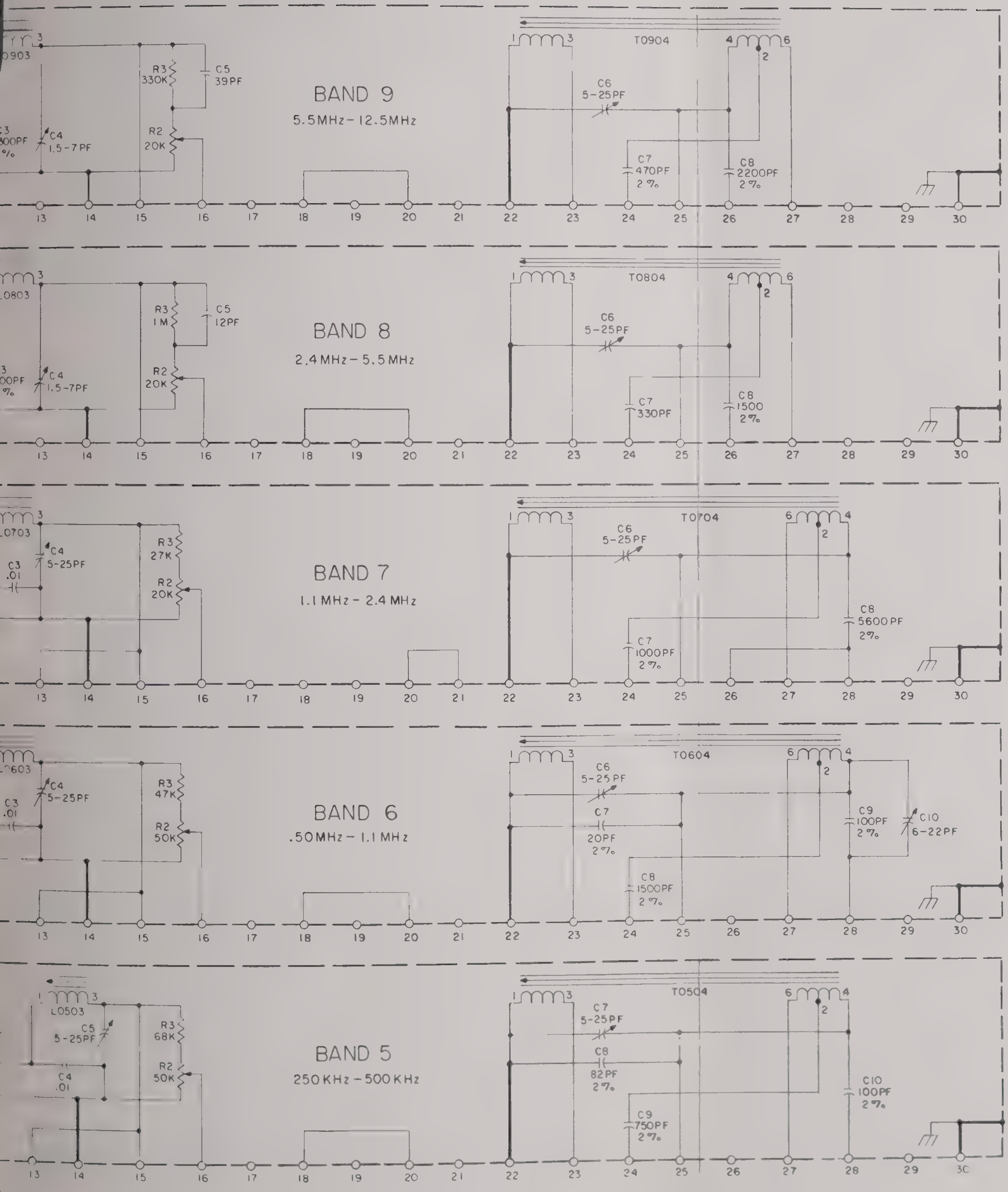
T0701
C1
5-25PF
L0702
R1
C2
5-25PF



T0601
C1
5-25PF
L0602
R1
C2
5-25PF



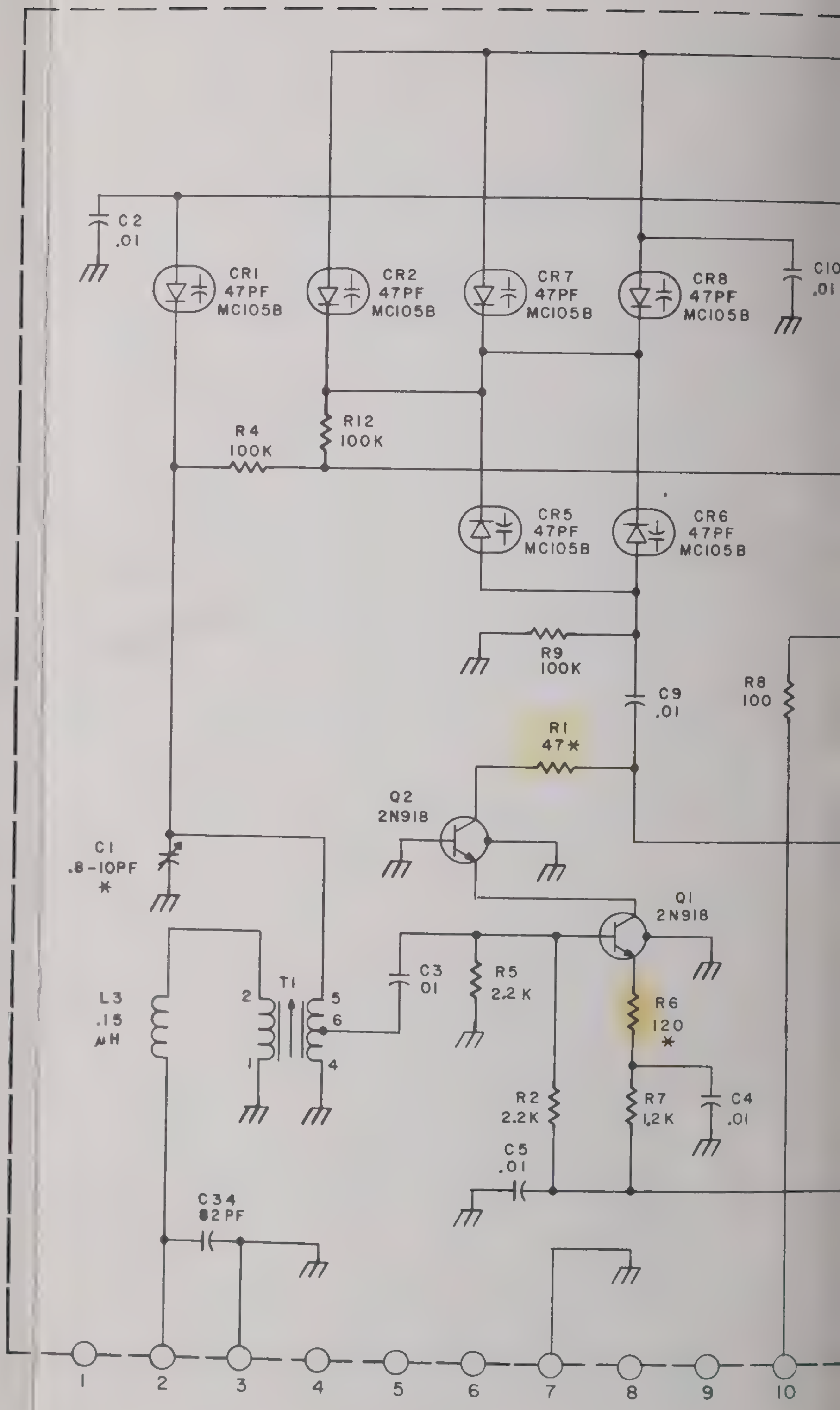
T0501
C1
5-25PF
L0502
R1
C3
5-25

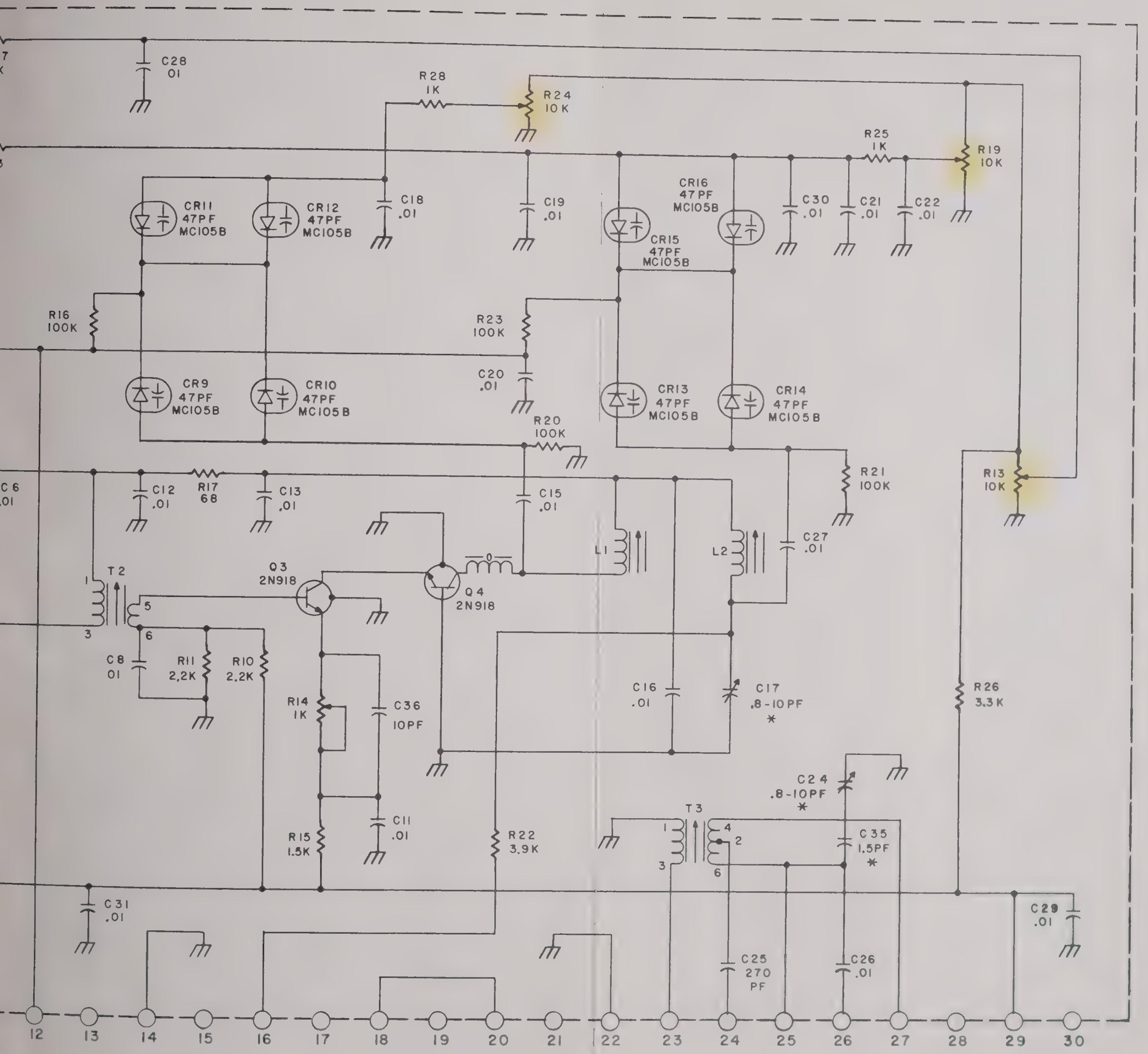


NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.6
RF Band Segments 1-9
(A2A1-A2A9)

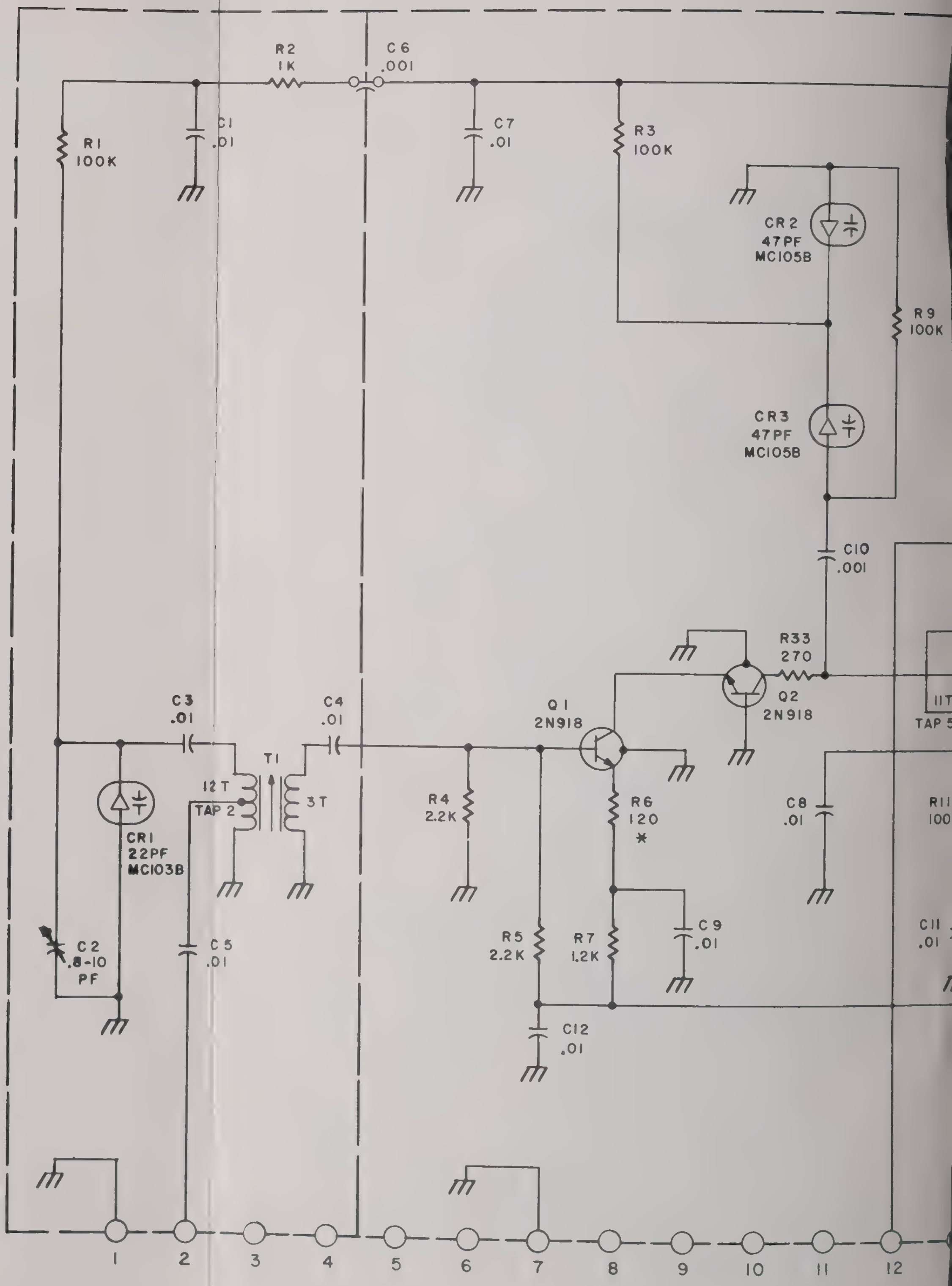

C2
.01
CR1
47PF
MC105B
CR2
47PF
MC105B
CR7
47PF
MC105B
CR8
47PF
MC105B
C10
.01
R4
100K
R12
100K
CR5
47PF
MC105B
CR6
47PF
MC105B
R9
100K
C9
.01
R8
100
R1
47*
Q2
2N918
Q1
2N918
C1
.8-10PF
*
L3
.15
µH
T1
2
1
5
6
4
C3
01
R5
2.2 K
R6
120
*
R2
2.2K
R7
1.2K
C4
.01
C5
.01
C34
82PF
1
2
3
4
5
6
7
8
9
10

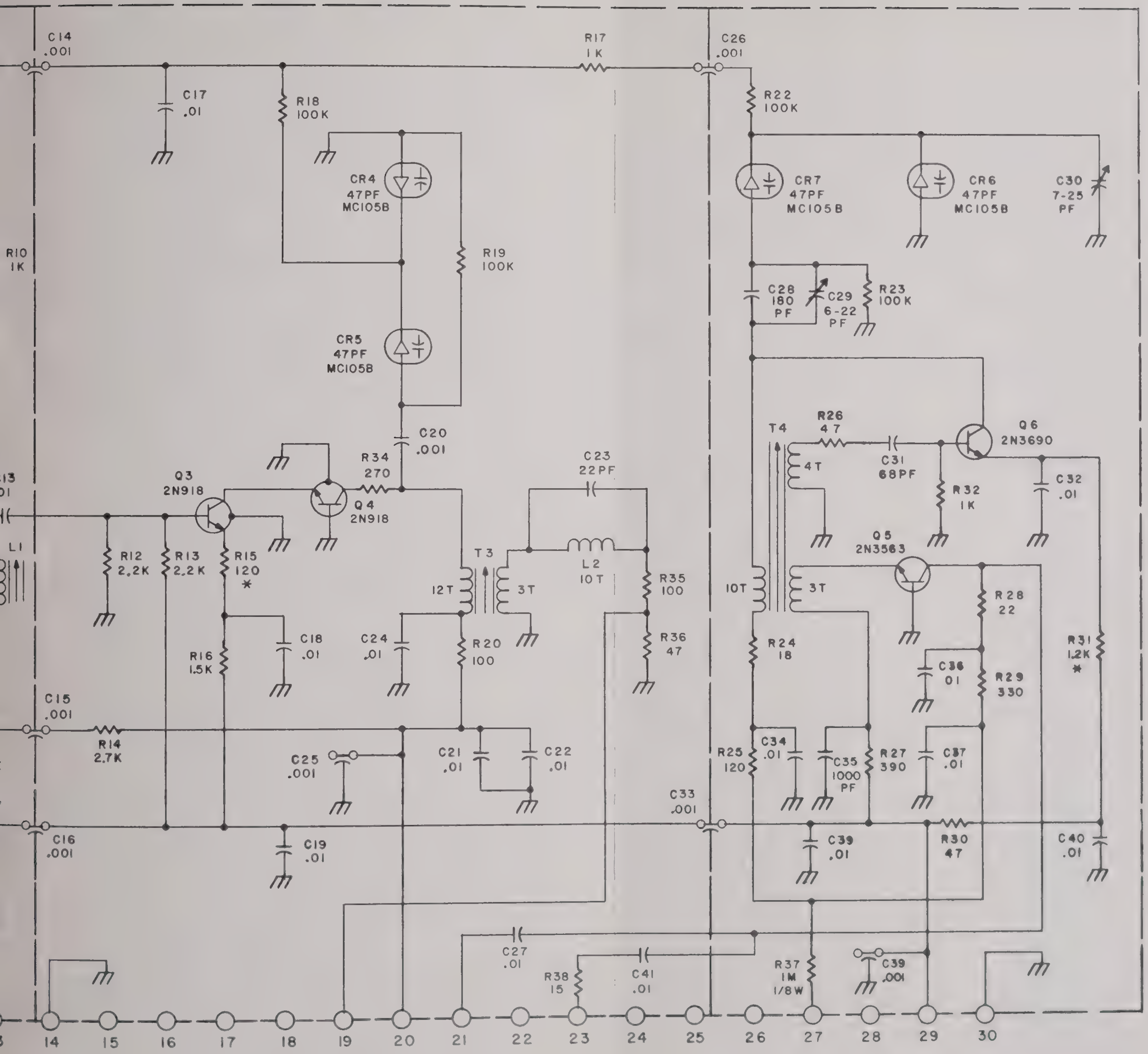


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.7
RF Band Segment 10
(A2A10)

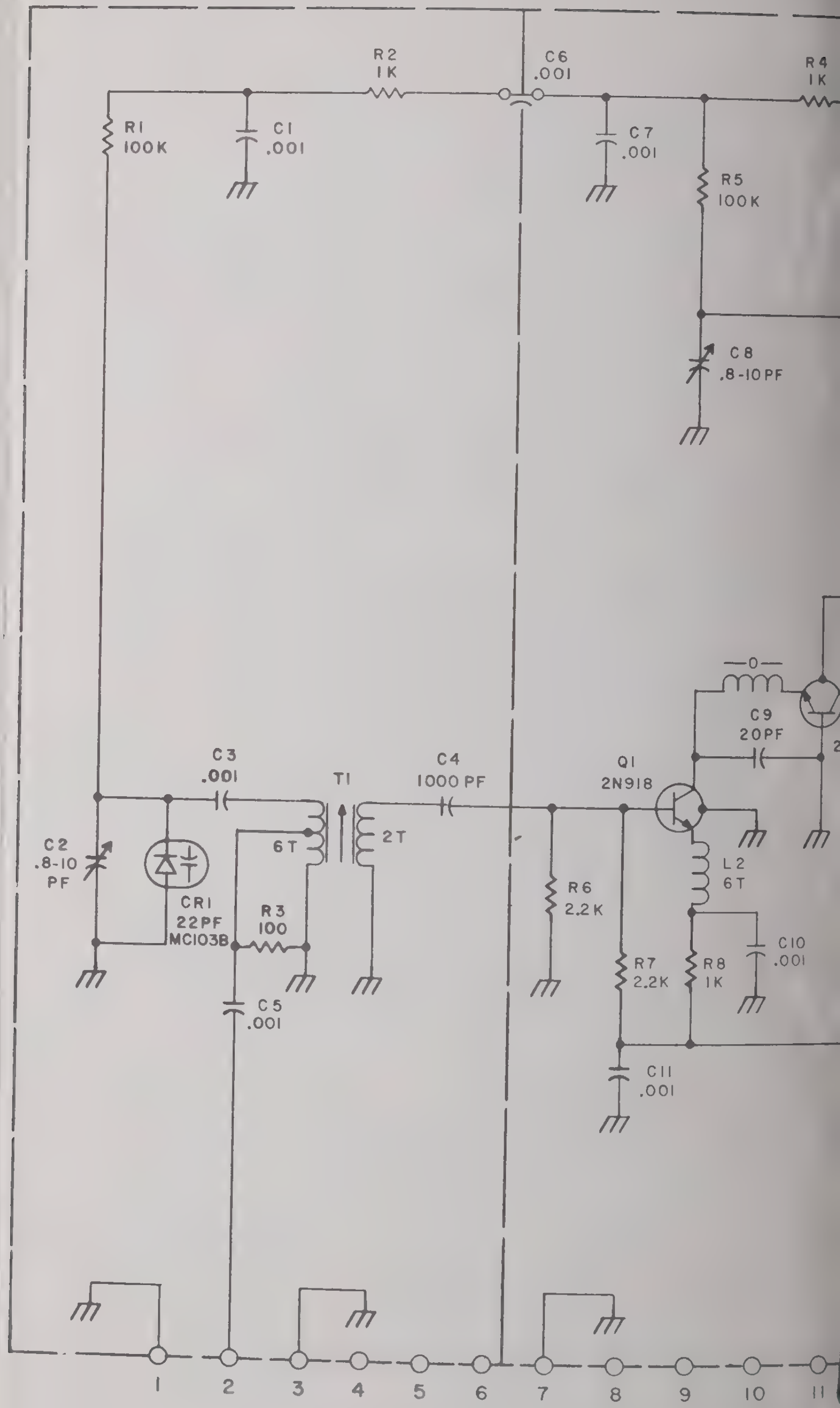

R2
1K
C6
.001
C1
.01
C7
.01
R1
100K
R3
100K
CR2
47PF
MC105B
R9
100K
CR3
47PF
MC105B
C10
.001
R33
270
Q2
2N918
IIT
TAP 5
Q1
2N918
C3
.01
C4
.01
T1
12T
TAP 2
3T
R4
2.2K
R6
120
*
C8
.01
R11
100
CR1
22PF
MC103B
C2
.8-10
PF
C5
.01
R5
2.2K
R7
1.2K
C9
.01
C11
.01
C12
.01
1
2
3
4
5
6
7
8
9
10
11
12

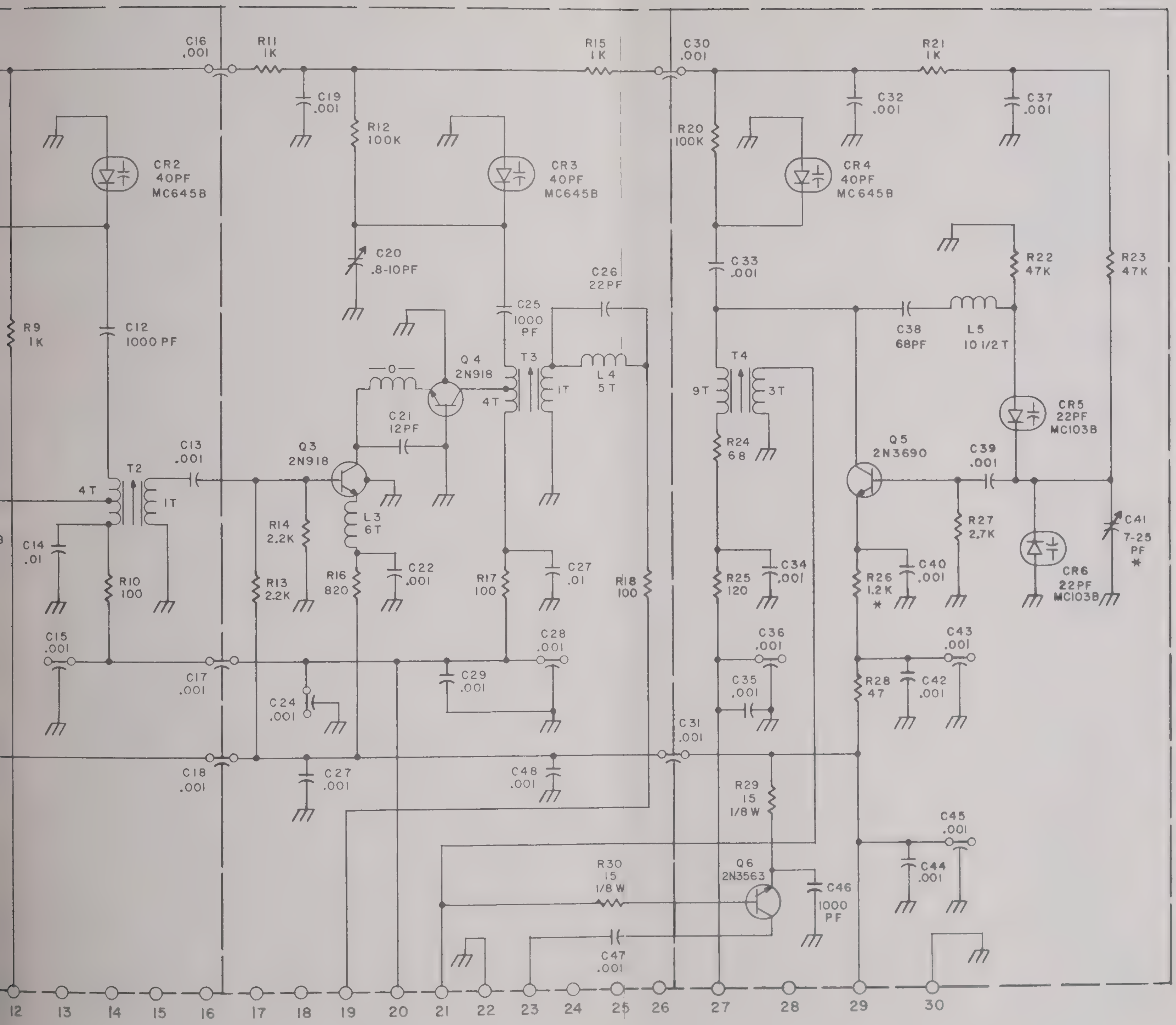


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS, ± 10% 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.8
RF Band Segment 11
(A2A11)

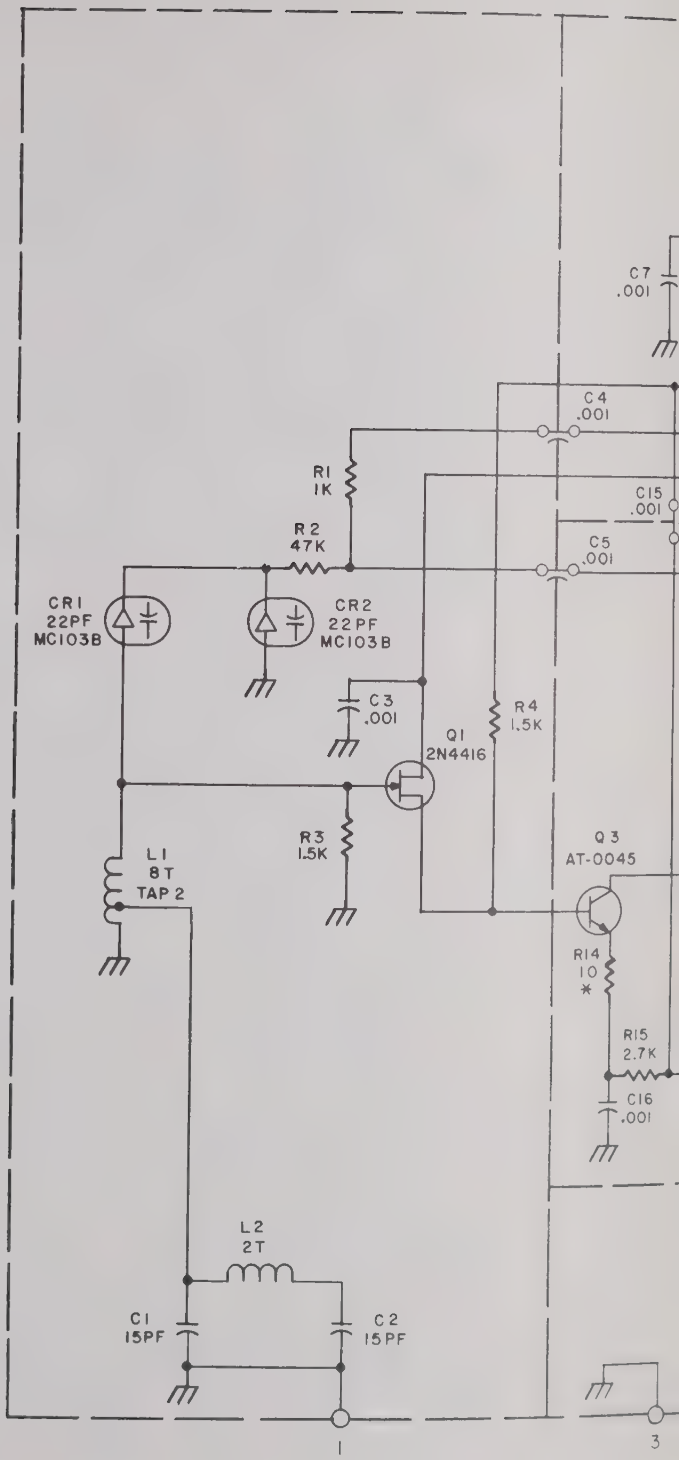

R2
1K
C6
.001
R4
1K
R1
100K
C1
.001
C7
.001
R5
100K
C8
.8-10PF
C9
20PF
C3
.001
T1
C4
1000 PF
Q1
2N918
6T
2T
C2
.8-10
PF
CR1
22PF
MC103B
R3
100
R6
2.2K
L2
6T
C10
.001
R7
2.2K
R8
1K
C5
.001
C11
.001
1
2
3
4
5
6
7
8
9
10
11

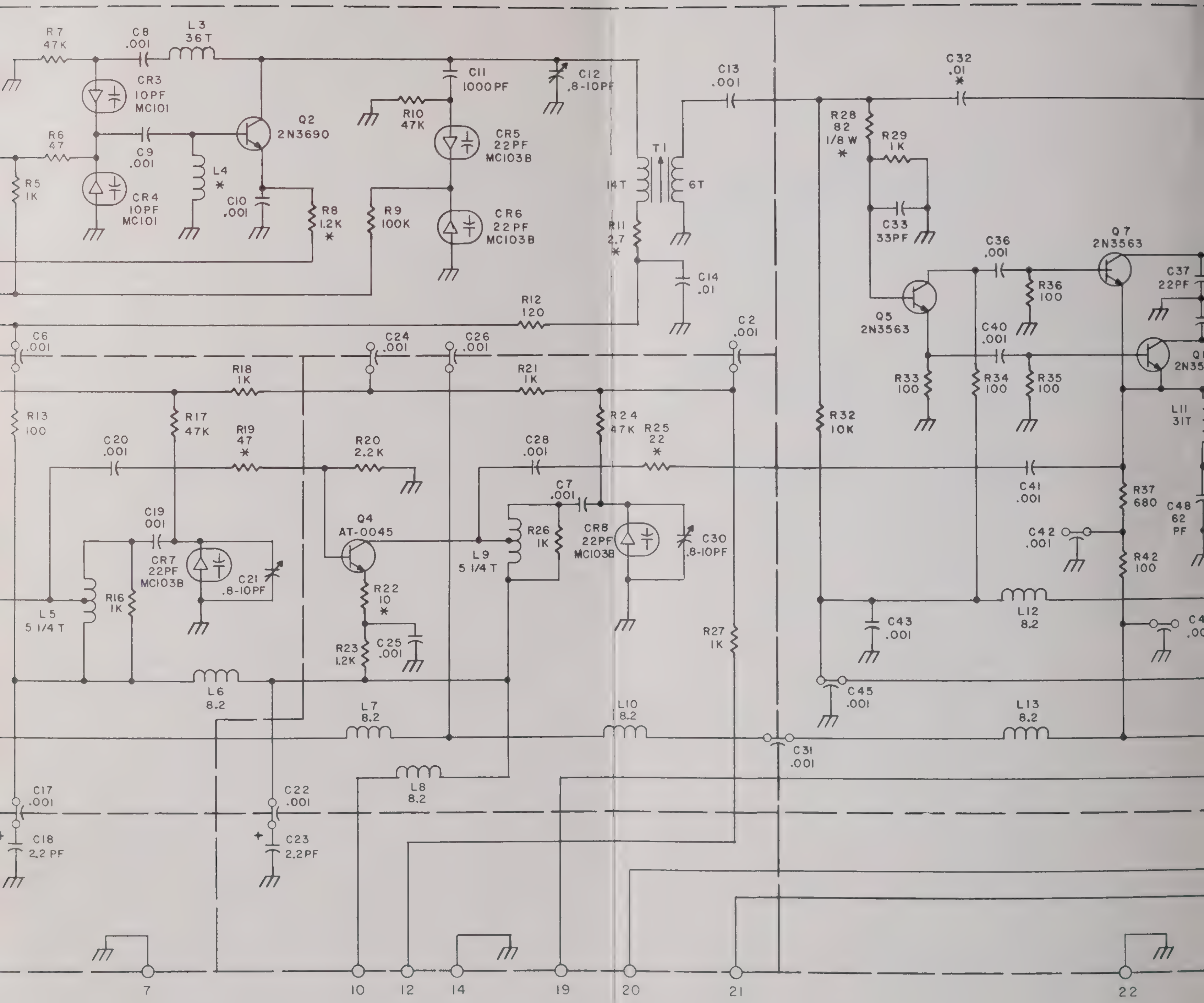


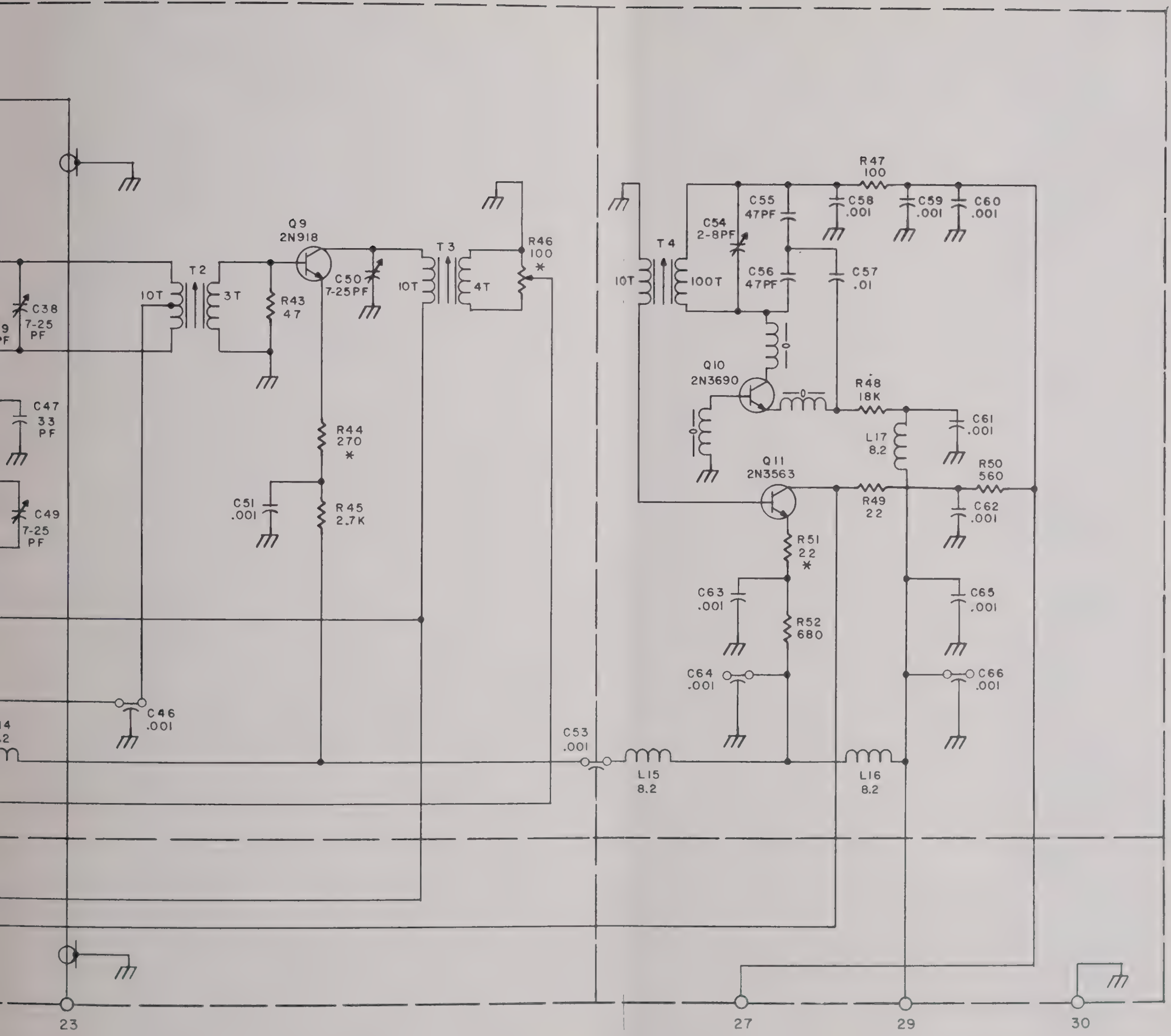
NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.
5. ALL COMPONENTS MARKED —0— ARE FERRITE BEADS.

Figure 6.9
RF Band Segment 12
(A2A12)


C7
.001
C4
.001
R1
1K
C15
.001
R2
47K
C5
.001
CR1
22PF
MC103B
CR2
22PF
MC103B
C3
.001
R4
1.5K
Q1
2N4416
Q3
AT-0045
R3
1.5K
L1
8T
TAP 2
R14
10
*
R15
2.7K
C16
.001
L2
2T
C1
15PF
C2
15PF
1
3

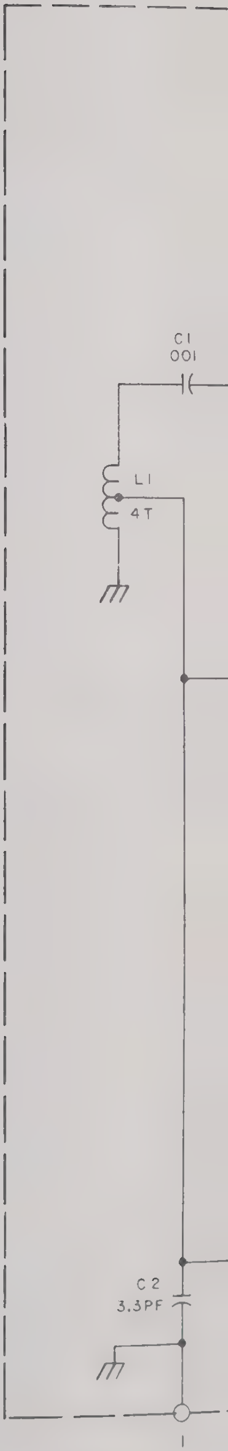

R7
47K
C8
.001
L3
36T
CR3
10PF
MC101
R6
47
C9
.001
R5
1K
CR4
10PF
MC101
L4
*
C10
.001
Q2
2N3690
R8
1.2K
*
C11
1000PF
R10
47K
CR5
22PF
MC103B
R9
100K
CR6
22PF
MC103B
C12
.8-10PF
T1
14T
6T
R11
2.7
*
C14
.01
R12
120
C13
.001
C32
.01
*
R28
82
1/8 W
*
R29
1K
C33
33PF
C36
.001
R36
100
Q7
2N3563
C37
22PF
Q5
2N3563
C40
.001
Q1
2N35
R33
100
R34
100
R35
100
L11
31T
R32
10K
C6
.001
C24
.001
C26
.001
C2
.001
R18
1K
R21
1K
R13
100
R17
47K
R19
47
*
R24
47K
R25
22
*
C20
.001
R20
2.2K
C28
.001
C41
.001
R37
680
C48
62
PF
C19
001
C7
.001
Q4
AT-0045
R26
1K
CR8
22PF
MC103B
C30
.8-10PF
C42
.001
R42
100
CR7
22PF
MC103B
C21
.8-10PF
L9
5 1/4 T
L5
5 1/4 T
R16
1K
R22
10
*
R23
1.2K
C25
.001
L12
8.2
C43
.001
R27
1K
C4
.00
L6
8.2
C45
.001
L7
8.2
L10
8.2
L13
8.2
C31
.001
L8
8.2
C17
.001
C22
.001
C18
2.2 PF
C23
2.2PF
+
+
7
10
12
14
19
20
21
22

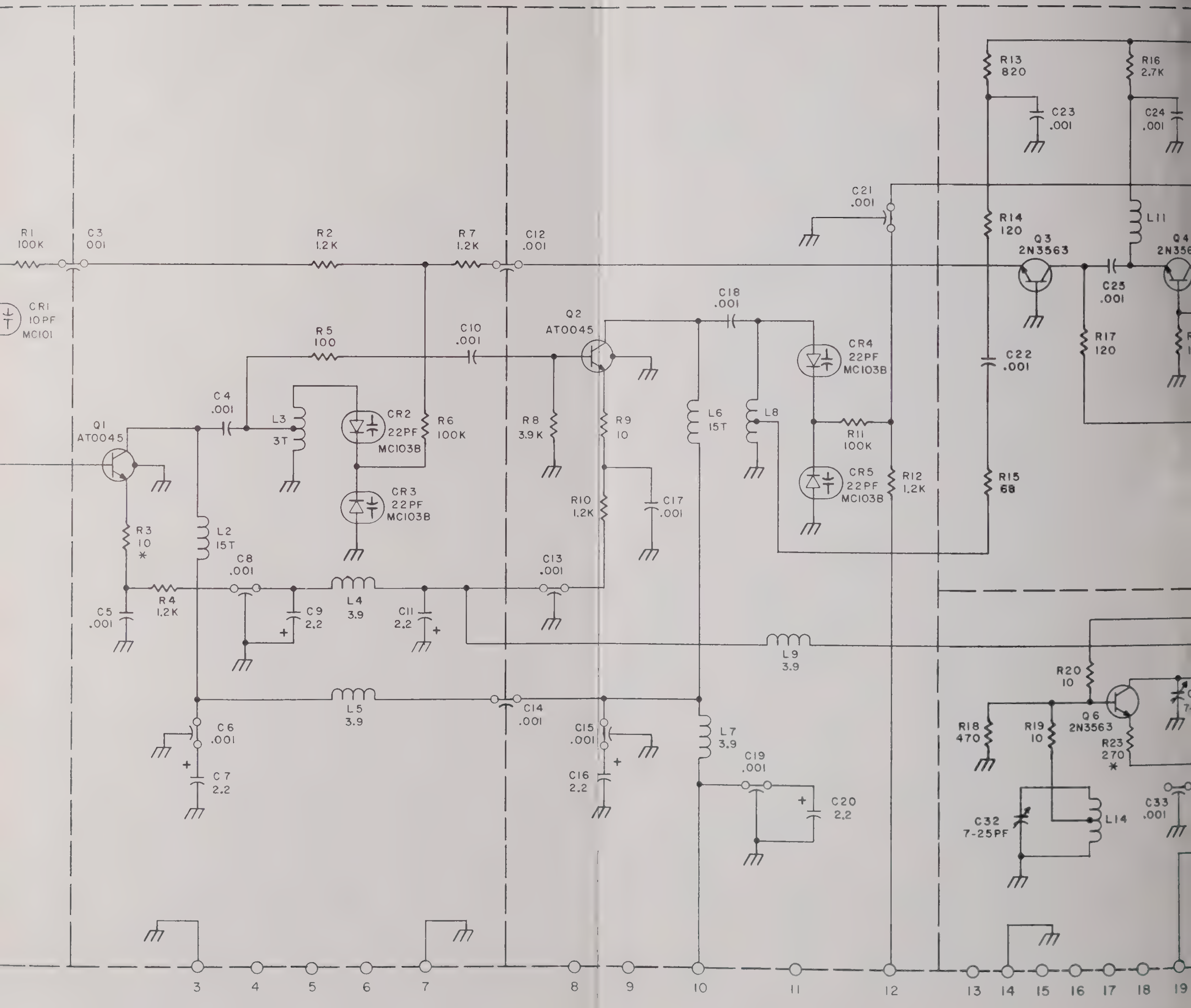


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.
5. ALL COMPONENTS MARKED —0— ARE FERRITE BEADS.

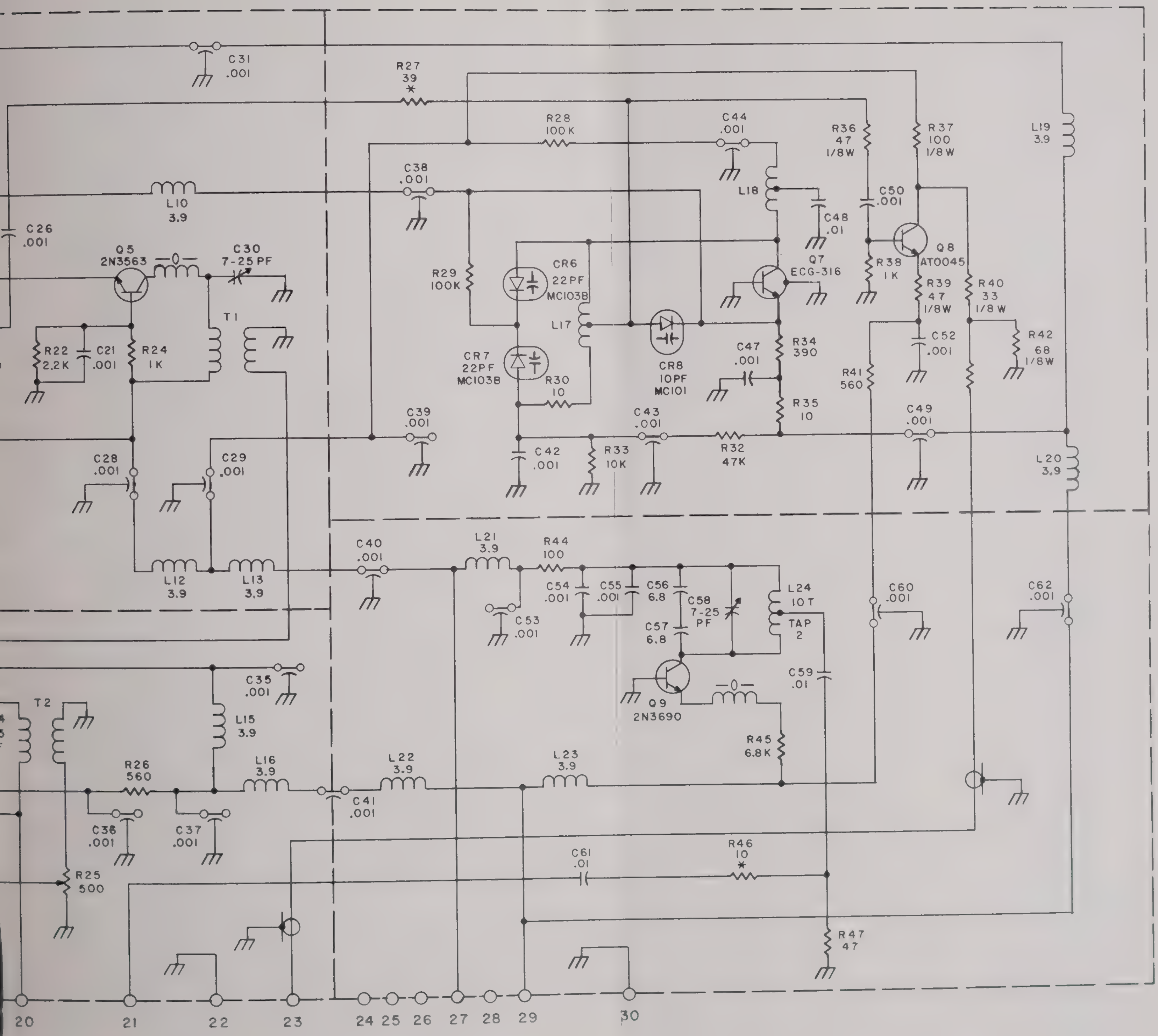
Figure 6.10
RF Band Segment 13
(A2A13)


C1
001
L1
4T
C2
3.3PF
1



NOTES: UNLES

1. ALL RE
2. ALL CA
3. ALL IN
4. ALL CO
5. ALL CO



OTHERWISE SPECIFIED:

STOR VALUES ARE IN OHMS ±10%, 1/4W.

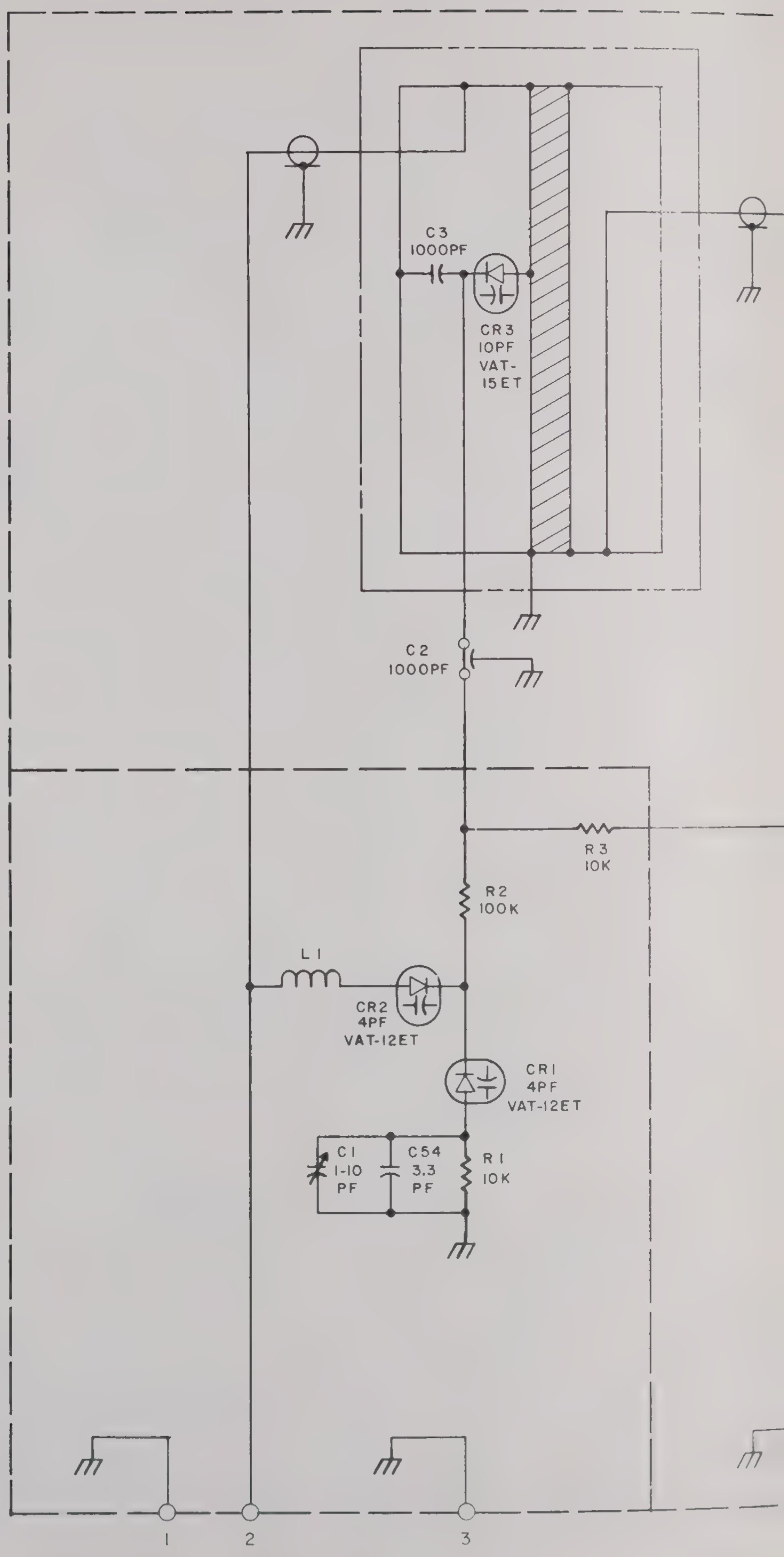
CITOR VALUES ARE IN MICROFARADS ±10%.

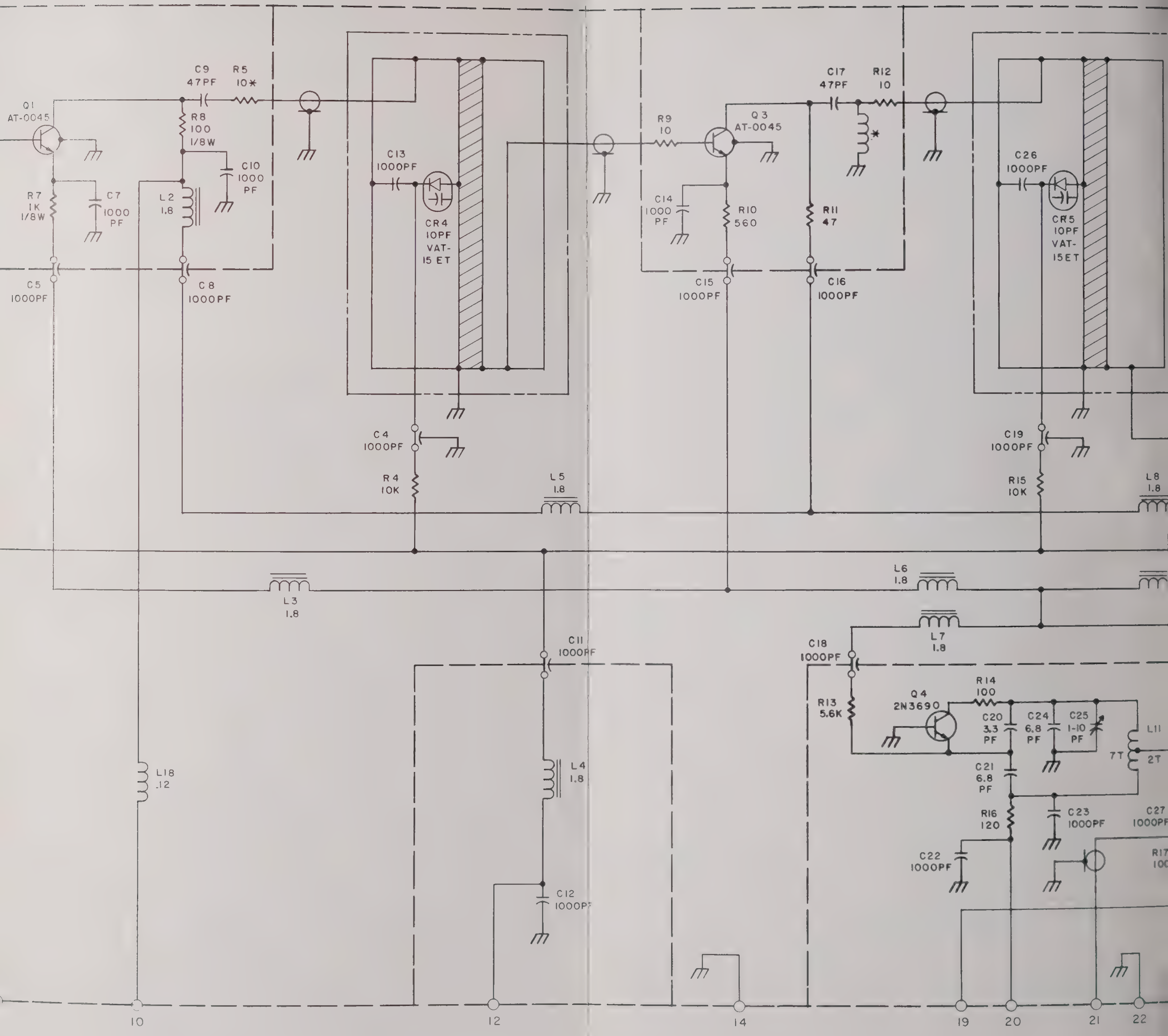
CTANCE VALUES ARE IN MICROHENRIES ±10%.

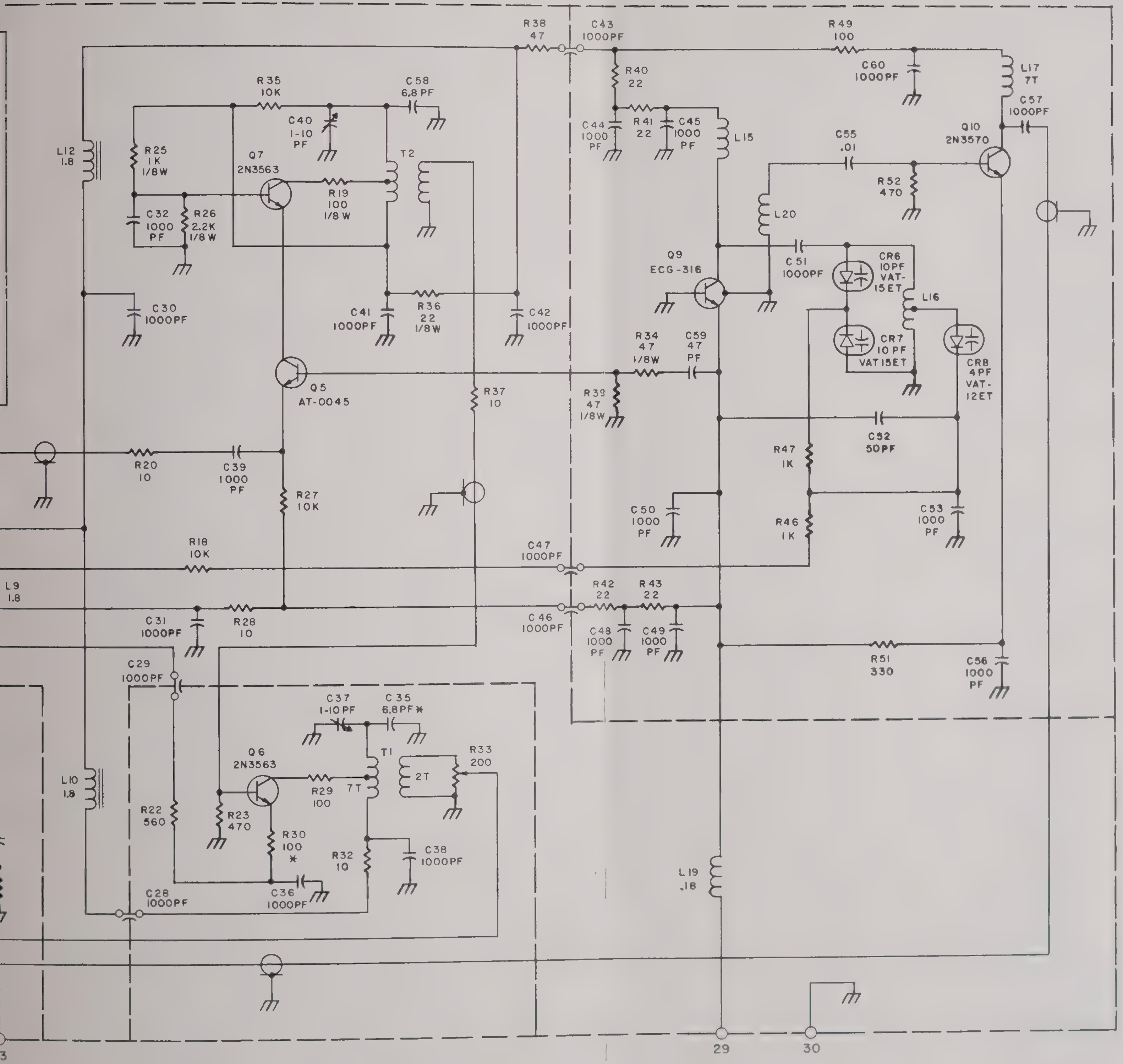
PONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

PONENTS MARKED —0— ARE FERRITE BEADS.

Figure 6.11
RF Band Segment 14
(A2A14)


C3
1000PF
CR3
10PF
VAT-
15ET
C2
1000PF
R3
10K
R2
100K
L1
CR2
4PF
VAT-12ET
CR1
4PF
VAT-12ET
C1
1-10
PF
C54
3.3
PF
R1
10K
1
2
3

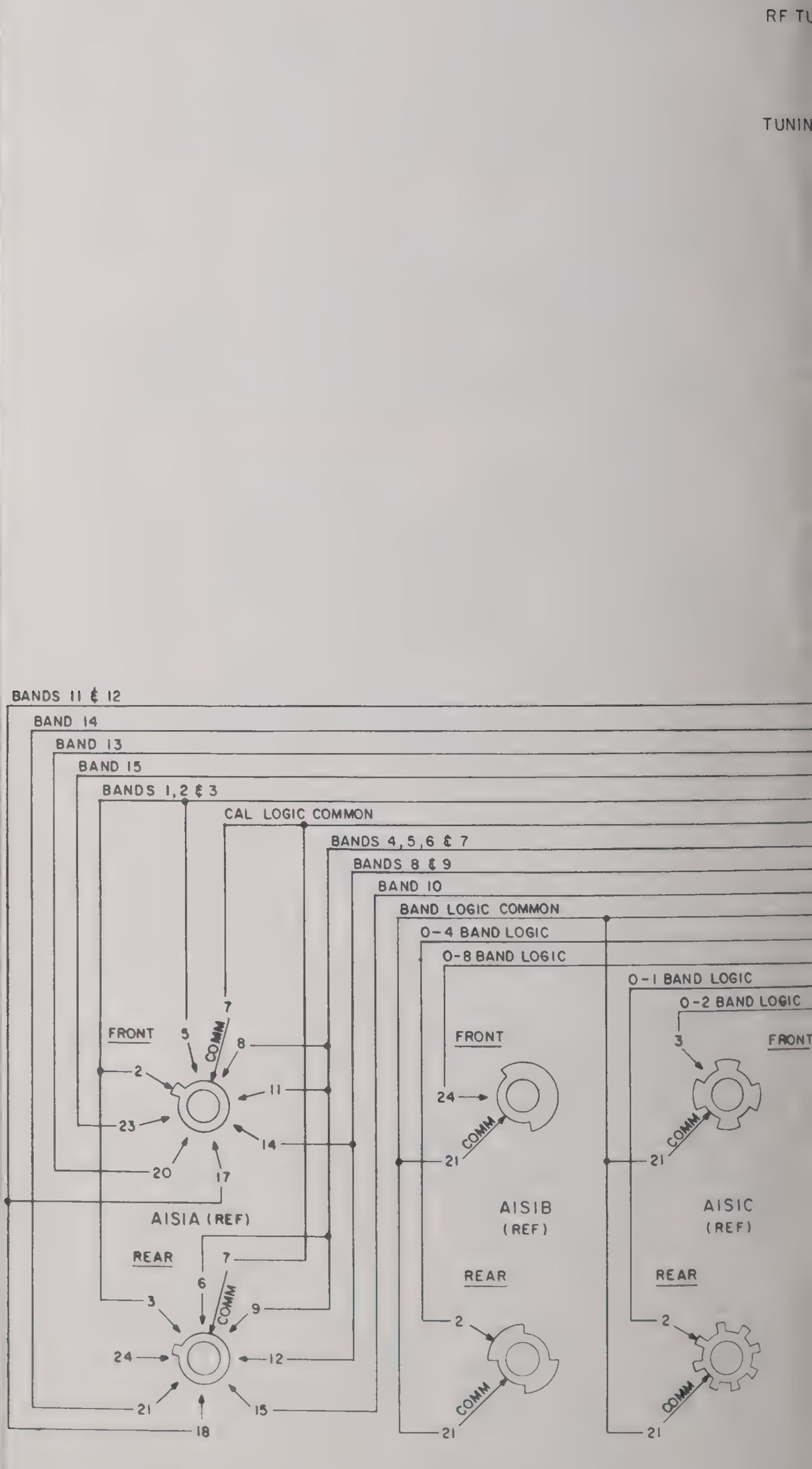

Q1
AT-0045
C9
47PF
R5
10*
R8
100
1/8W
C10
1000
PF
R7
1K
1/8W
C7
1000
PF
L2
1.8
C5
1000PF
C8
1000PF
C13
1000PF
CR4
10PF
VAT-
15 ET
C4
1000PF
R4
10K
L5
1.8
L3
1.8
R9
10
Q3
AT-0045
C17
47PF
R12
10
*
C14
1000
PF
R10
560
R11
47
C15
1000PF
C16
1000PF
C26
1000PF
CR5
10PF
VAT-
15ET
C19
1000PF
R15
10K
L8
1.8
L6
1.8
L7
1.8
C11
1000PF
L18
.12
L4
1.8
C12
1000PF
C18
1000PF
R13
5.6K
Q4
2N3690
R14
100
C20
3.3
PF
C24
6.8
PF
C25
1-10
PF
L11
7T
2T
C21
6.8
PF
R16
120
C23
1000PF
C27
1000PF
R17
100
C22
1000PF
10
12
14
19
20
21
22



NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10 %.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.12
RF Band Segment 15
(A2A15)



RF TU
TUNIN
BANDS 11 & 12
BAND 14
BAND 13
BAND 15
BANDS 1,2 & 3
CAL LOGIC COMMON
BANDS 4,5,6 & 7
BANDS 8 & 9
BAND 10
BAND LOGIC COMMON
0-4 BAND LOGIC
0-8 BAND LOGIC
0-1 BAND LOGIC
0-2 BAND LOGIC
FRONT
5
7
COMM
8
2
11
23
14
20
17
AISIA (REF)
REAR
7
6
COMM
3
9
24
12
21
18
15
FRONT
24
COMM
21
AISIB
(REF)
REAR
2
COMM
21
3
FRONT
COMM
21
AISIC
(REF)
REAR
2
COMM
21

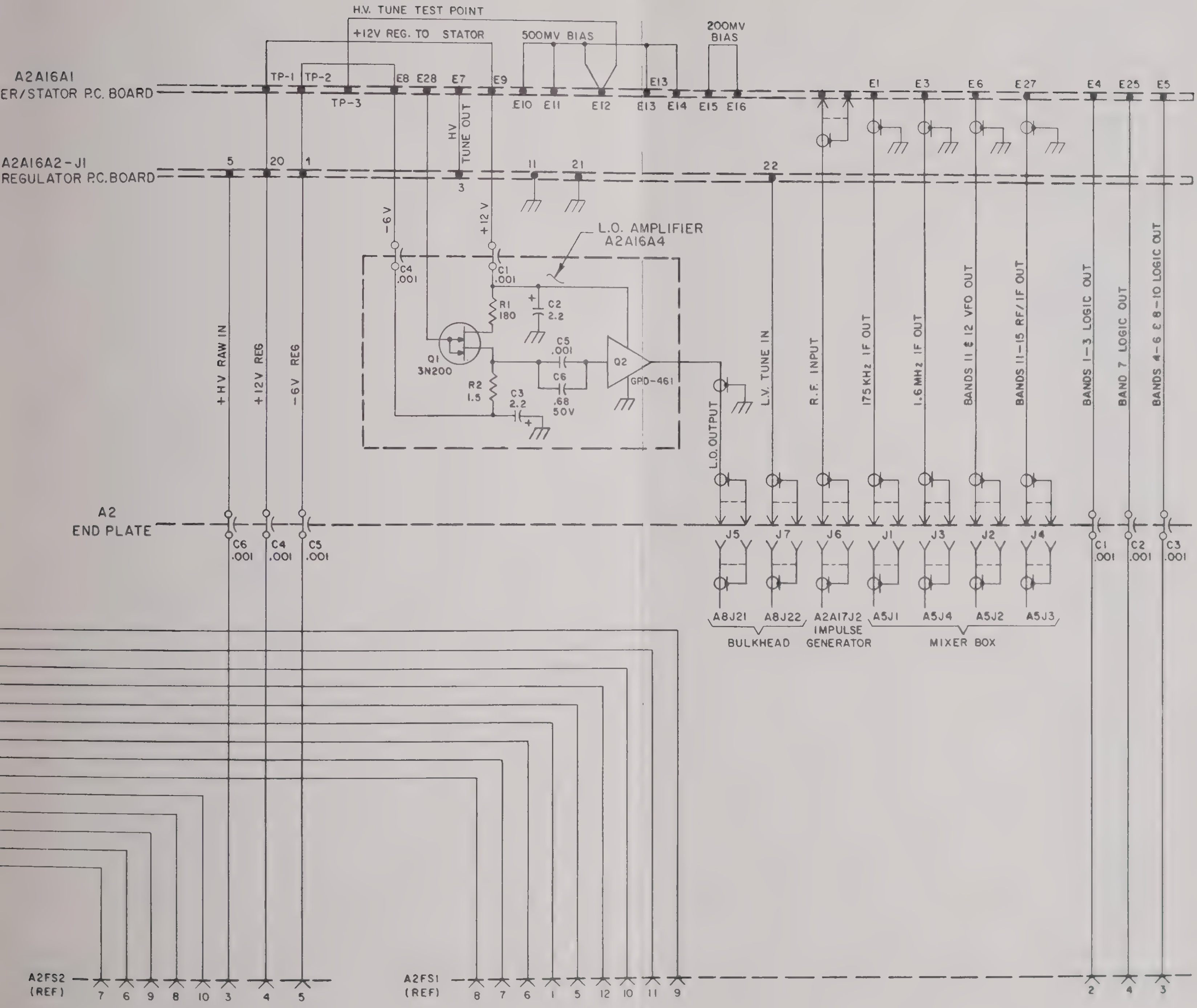
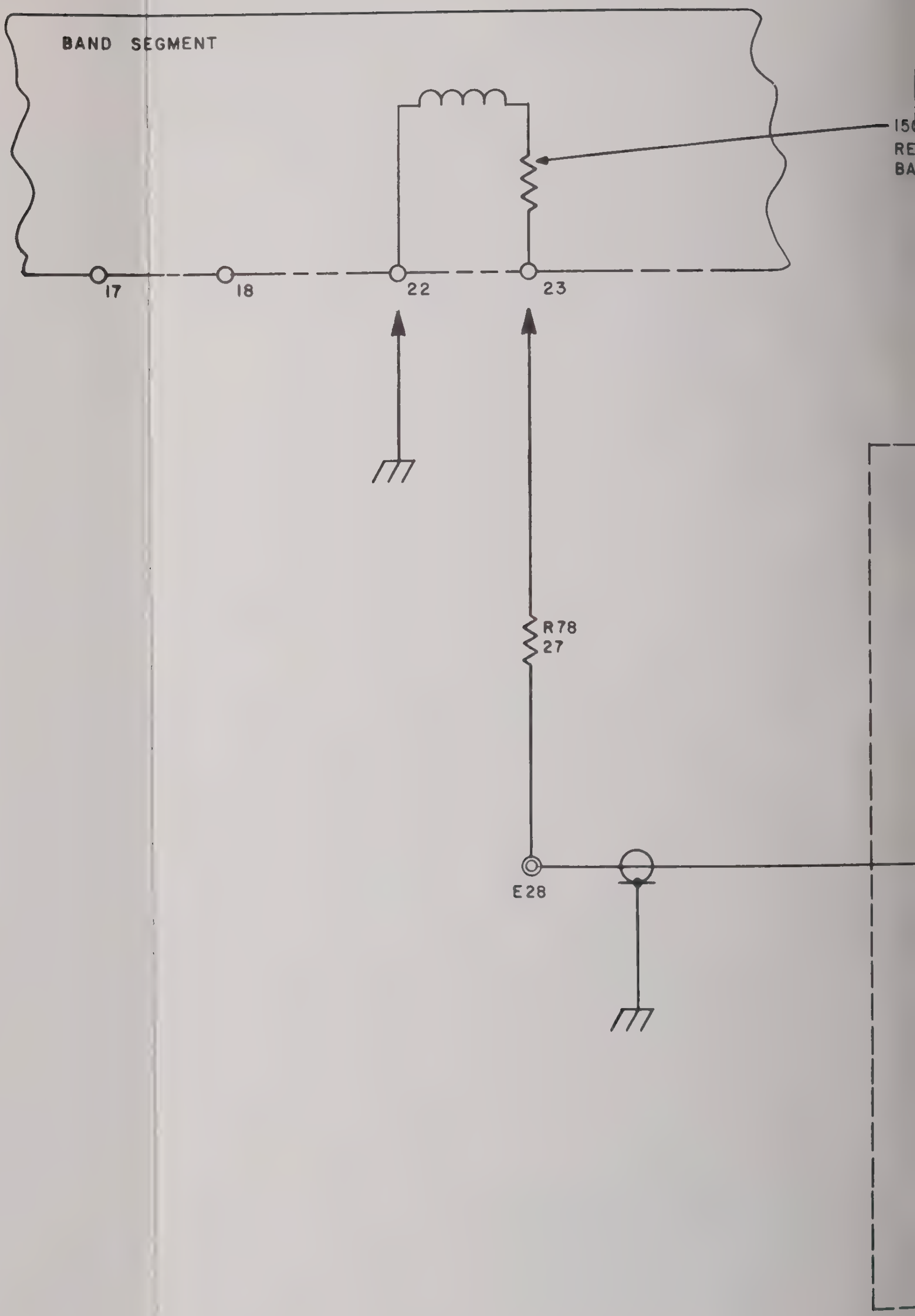
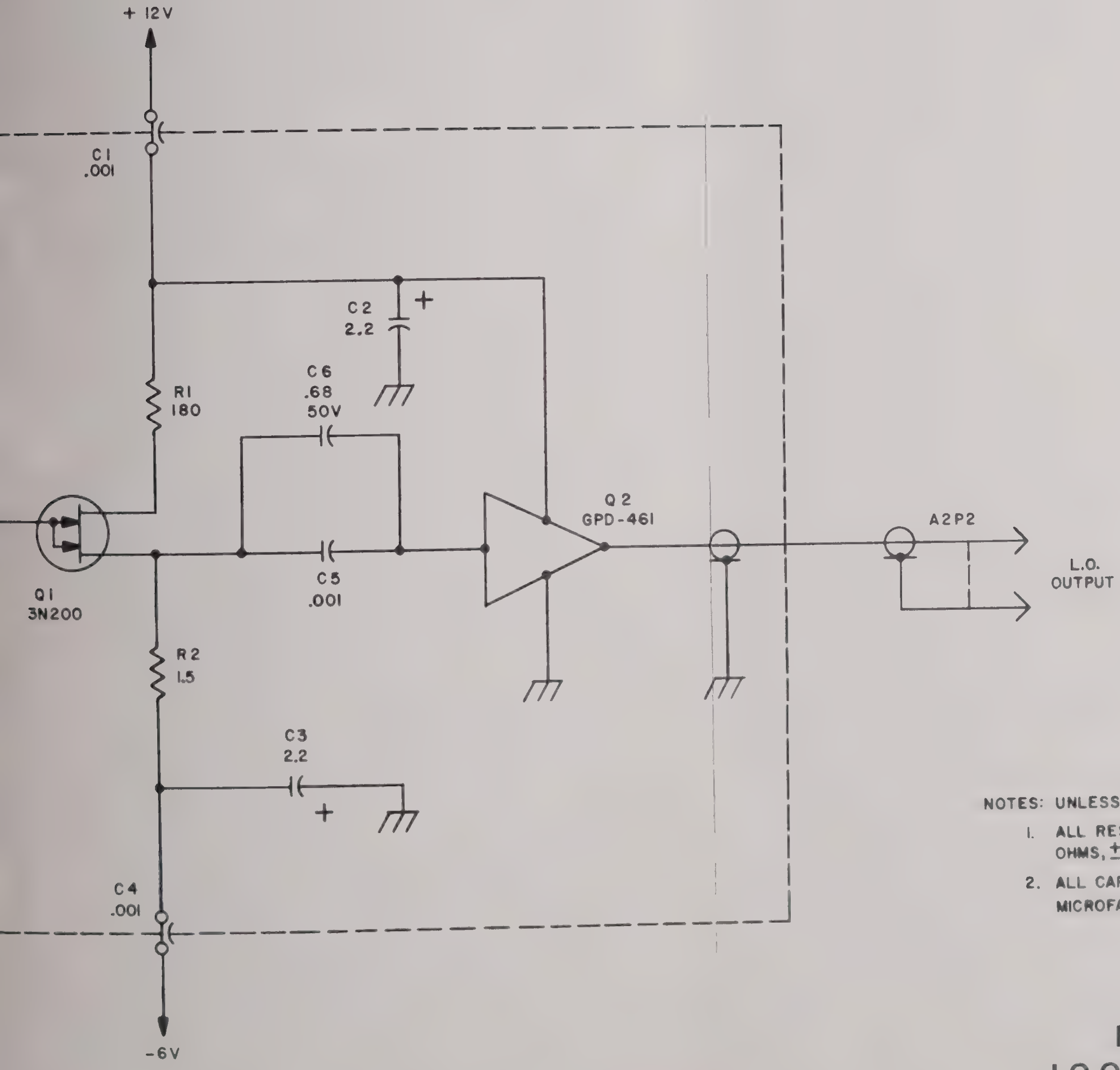


Figure 6.13
Tuner Interconnections


BAND SEGMENT
17
18
22
23
R78
27
E28
15
RE
BA

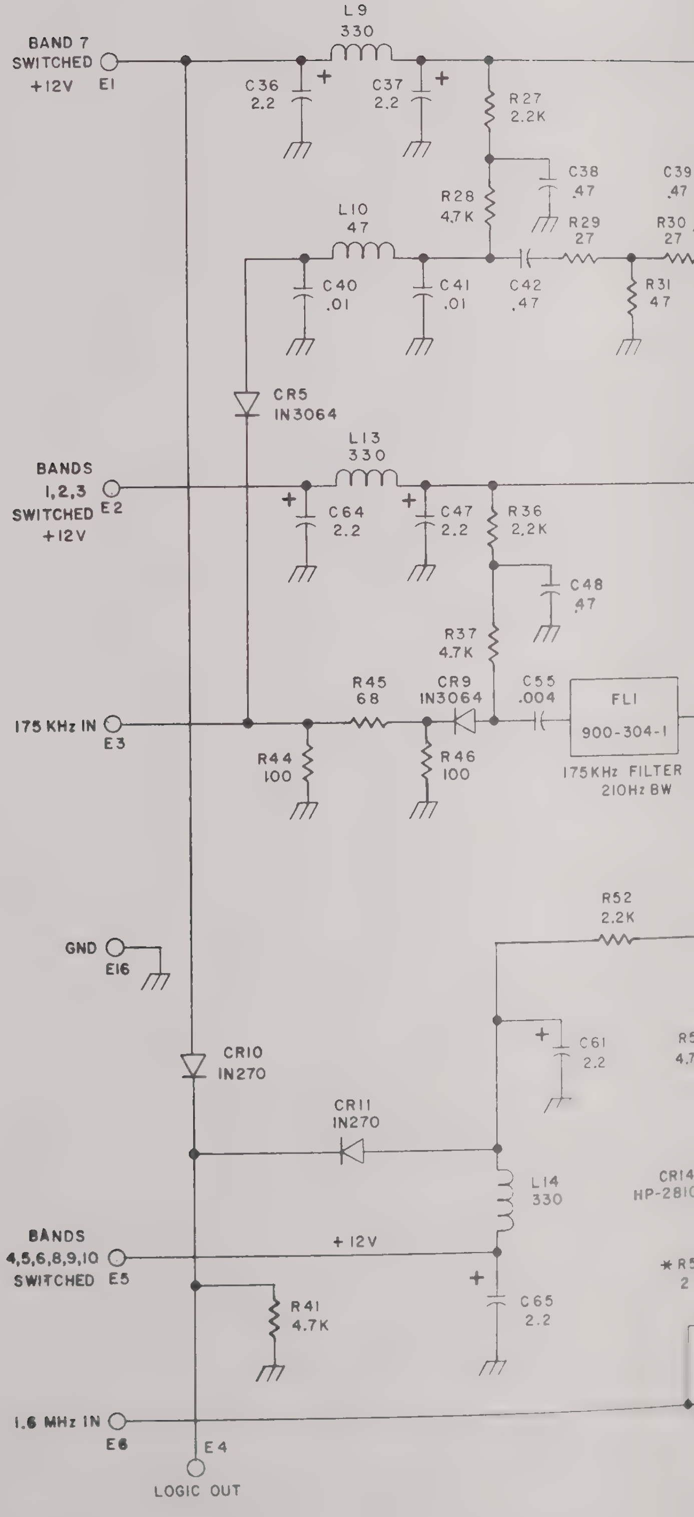
10%, 1/4W
TOR SHOWN ONLY ON
10 FOR L.O. OPTION

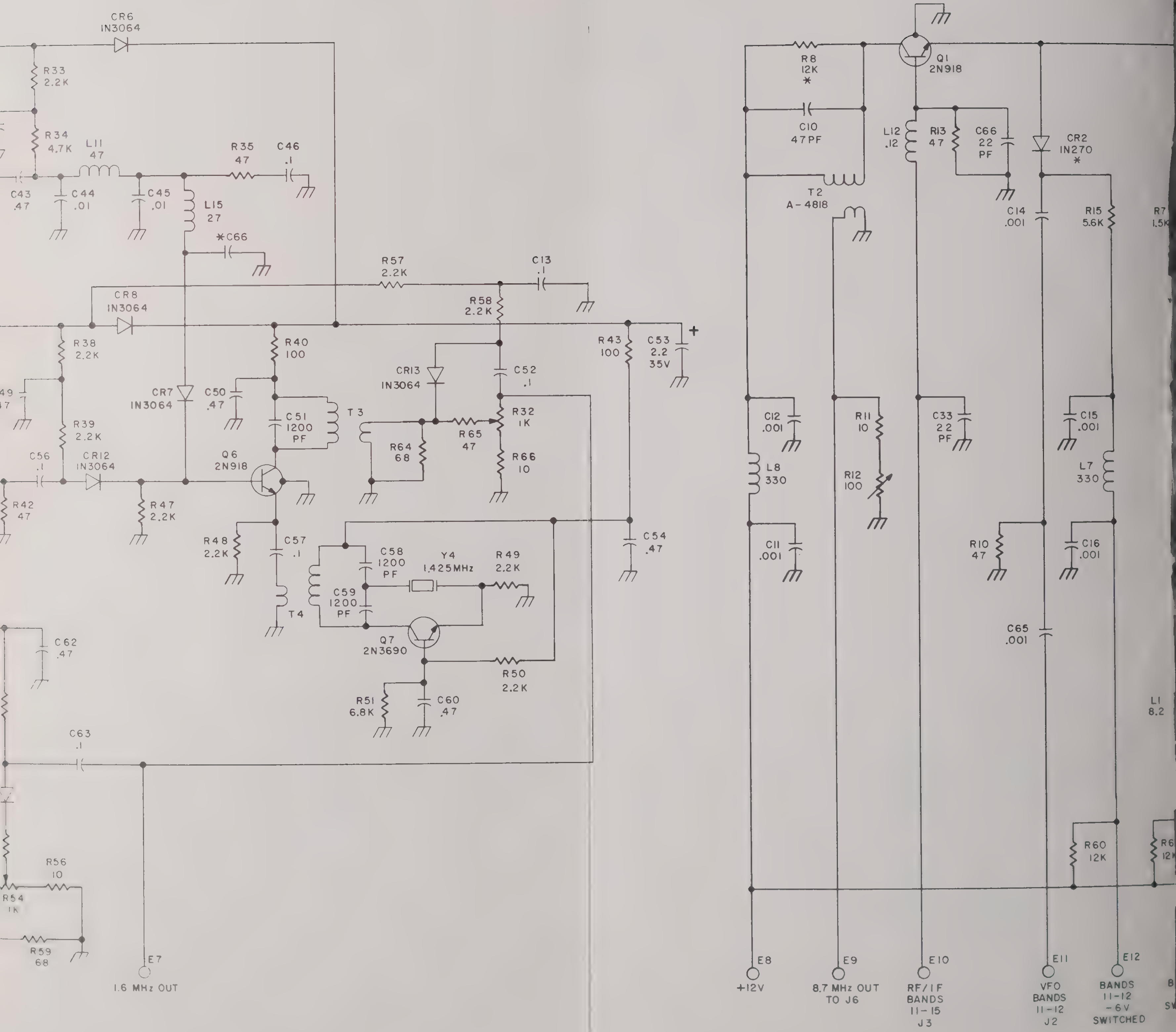


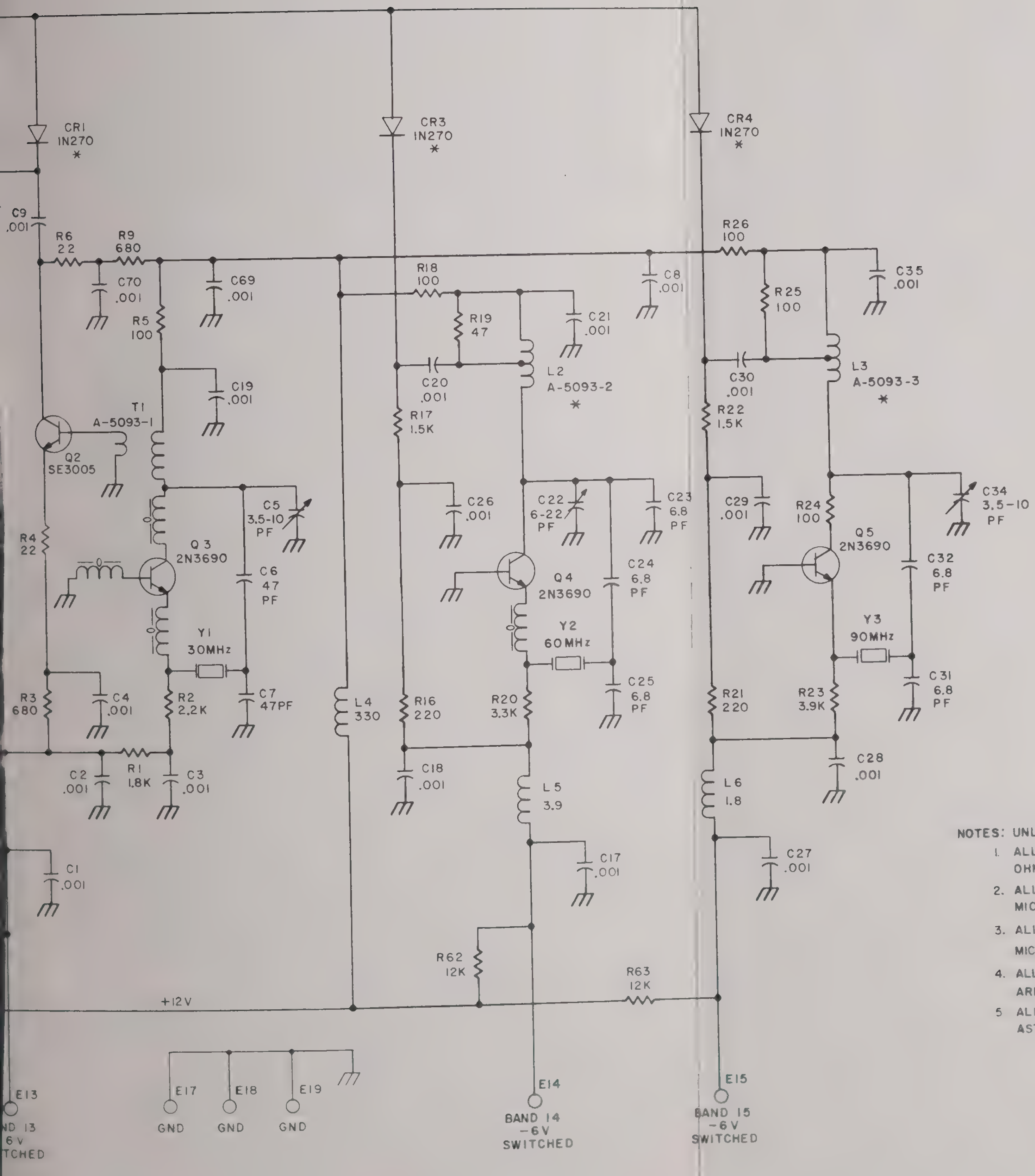
NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%.

Figure 6.14
LO Output Amplifier
(A2A16A4)


BAND 7
SWITCHED
+12V
E1
L9
330
C36
2.2
C37
2.2
R27
2.2K
C38
.47
C39
.47
R28
4.7K
L10
47
R29
27
R30
27
C40
.01
C41
.01
C42
.47
R31
47
CR5
IN3064
L13
330
BANDS
1,2,3
SWITCHED
+12V
E2
C64
2.2
C47
2.2
R36
2.2K
C48
.47
R37
4.7K
R45
68
CR9
IN3064
C55
.004
FL1
900-304-1
175 KHz IN
E3
R44
100
R46
100
175KHz FILTER
210Hz BW
R52
2.2K
GND
E16
C61
2.2
CR10
IN270
CR11
IN270
L14
330
BANDS
4,5,6,8,9,10
SWITCHED
E5
+ 12V
C65
2.2
R41
4.7K
1.6 MHz IN
E6
E4
LOGIC OUT

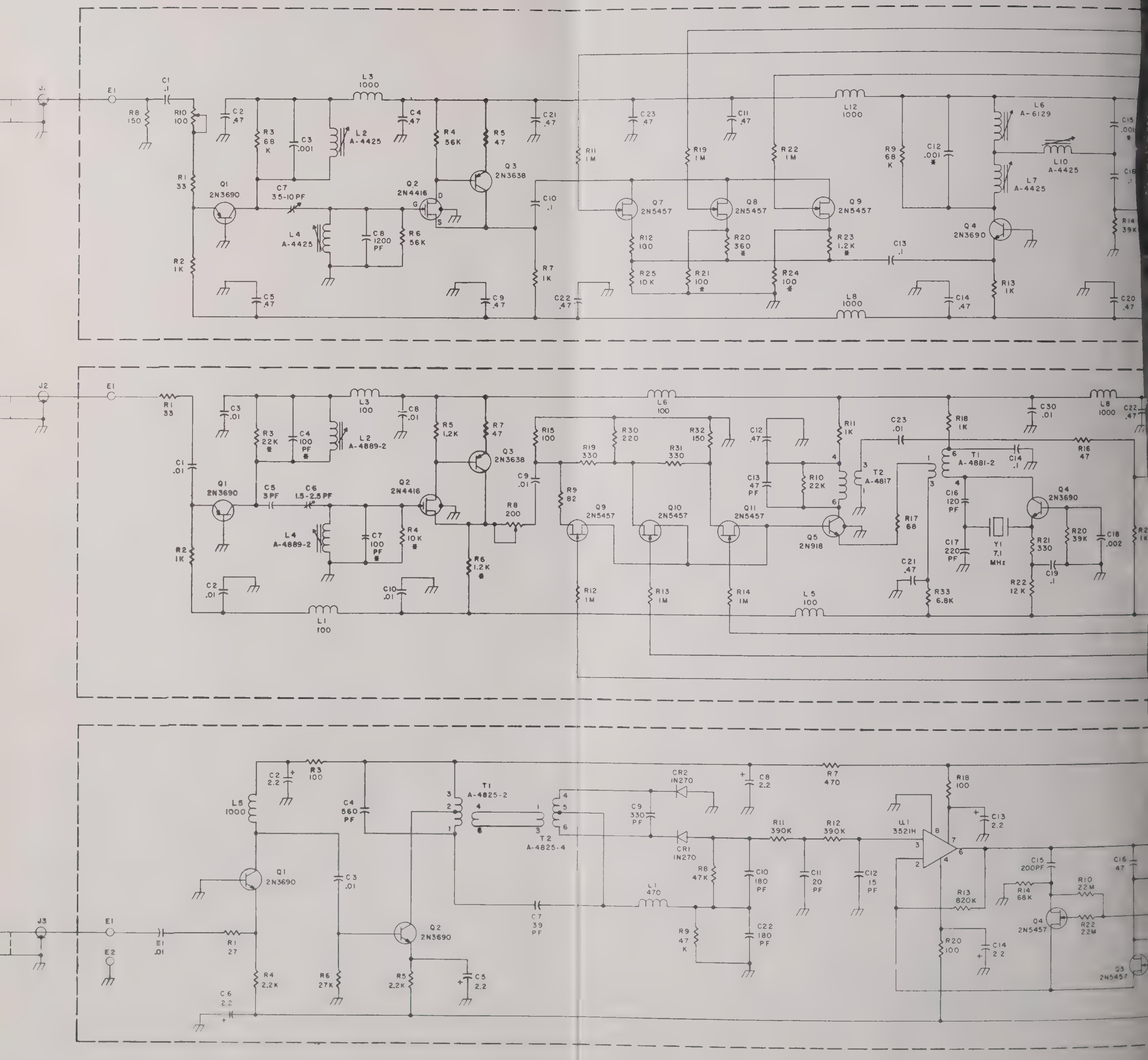

CR6
IN3064
R33
2.2K
R34
4.7K
L11
47
R35
47
C46
.1
C43
.47
C44
.01
C45
.01
L15
27
*C66
R57
2.2K
C13
.1
CR8
IN3064
R58
2.2K
R38
2.2K
R40
100
R43
100
C53
2.2
35V
+
CR13
IN3064
C52
.1
CR7
IN3064
C50
.47
C51
1200
PF
T3
R32
1K
R39
2.2K
R64
68
R65
47
R66
10
C56
.1
CR12
IN3064
Q6
2N918
R42
47
R47
2.2K
R48
2.2K
C57
.1
C54
.47
C58
1200
PF
Y4
1.425MHz
R49
2.2K
C59
1200
PF
T4
Q7
2N3690
R50
2.2K
R51
6.8K
C60
.47
C62
.47
C63
.1
R56
10
R54
1K
R59
68
E7
1.6 MHz OUT
R8
12K
*
Q1
2N918
C10
47PF
L12
.12
R13
47
C66
22
PF
CR2
IN270
*
T2
A-4818
C14
.001
R15
5.6K
R7
1.5K
C12
.001
R11
10
C33
22
PF
C15
.001
L8
330
R12
100
L7
330
C11
.001
R10
47
C16
.001
C65
.001
L1
8.2
R60
12K
R6
12K
E8
+12V
E9
8.7 MHz OUT
TO J6
E10
RF/IF
BANDS
11-15
J3
E11
VFO
BANDS
11-12
J2
E12
BANDS
11-12
-6V
SWITCHED

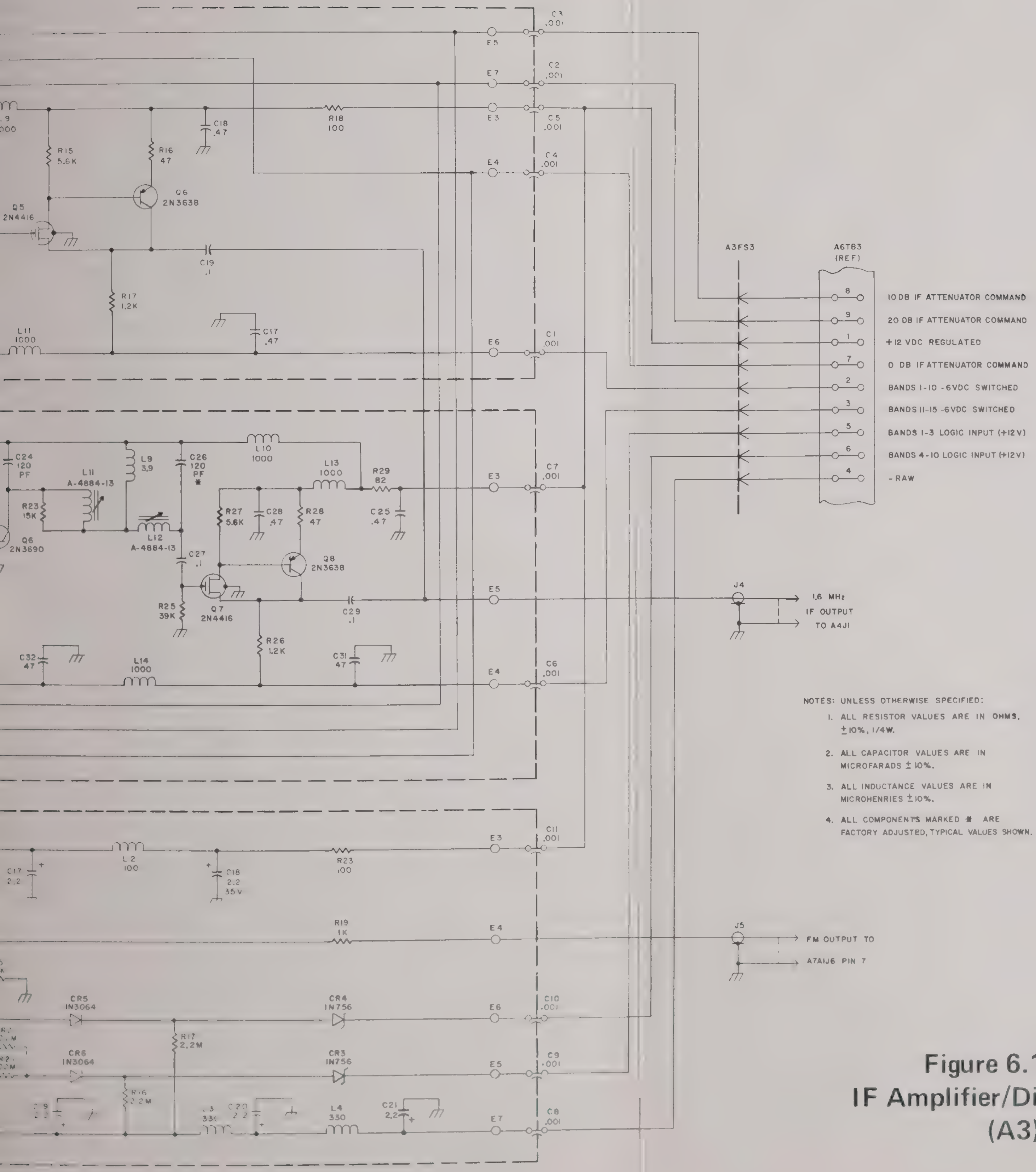


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS, ± 10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARDS, ± 20%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. ALL COMPONENTS MARKED ARE FERRITE BEADS.
5. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST

Figure 6.15
Mixed BD
(A5A1)

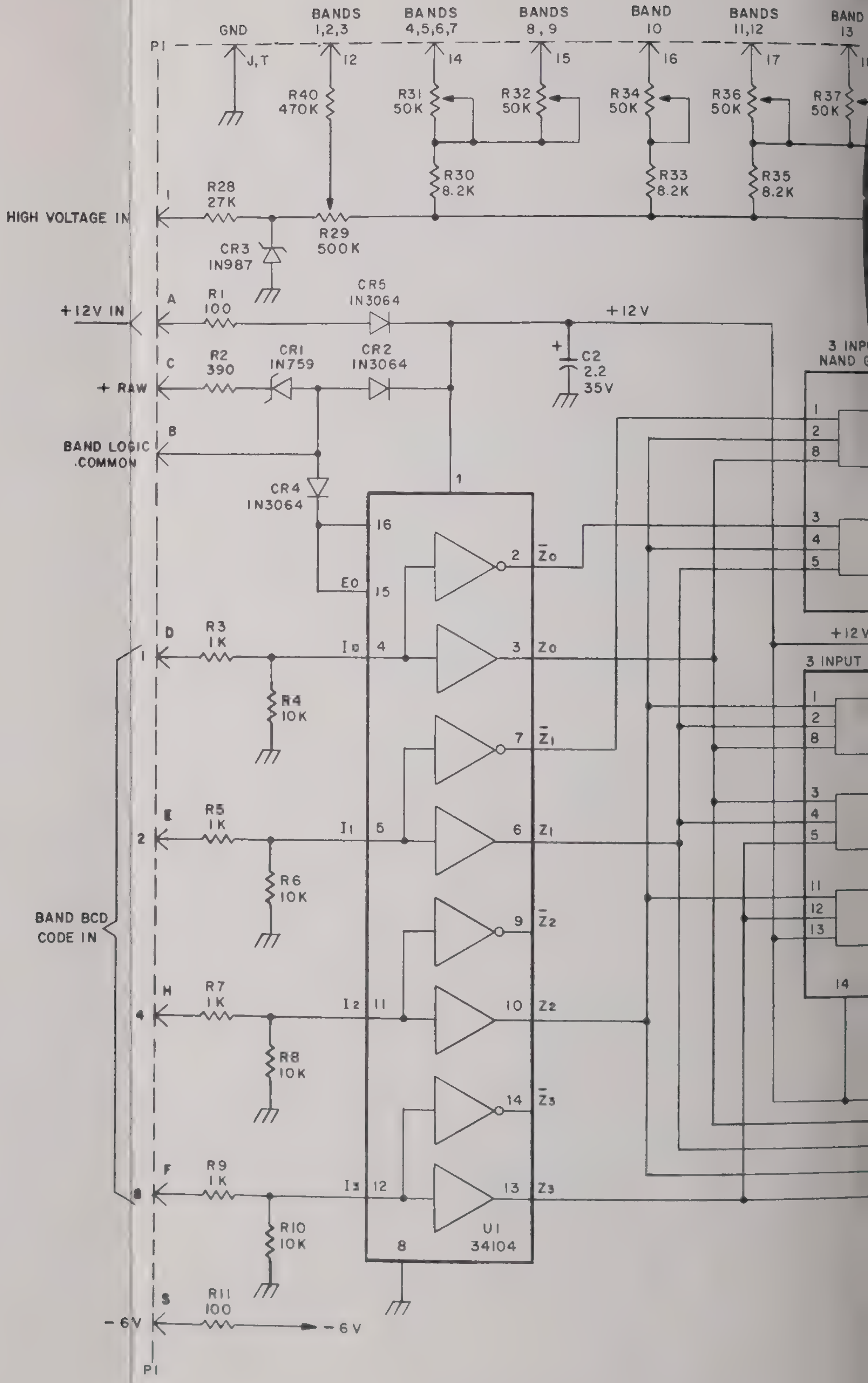

J.
E1
C1 .1
R8 150
R10 100
C2 .47
R3 68 K
C3 .001
L3 1000
L2 A-4425
C4 .47
R4 56K
R5 47
Q3 2N3638
C21 .47
R1 33
Q1 2N3690
C7 35-10 PF
Q2 2N4416
D
G
S
L4 A-4425
C8 1200 PF
R6 56K
C10 .1
R2 1K
C5 .47
C9 .47
R7 1K
C22 .47
R11 1M
C23 .47
C11 .47
R19 1M
R22 1M
L12 1000
R9 68 K
C12 .001 *
L6 A-6129
C15 .001 *
L10 A-4425
C16 .1
L7 A-4425
Q7 2N5457
Q8 2N5457
Q9 2N5457
Q4 2N3690
R14 39K
R12 100
R20 360 *
R23 1.2K *
C13 .1
R25 10K
R21 100 *
R24 100 *
L8 1000
C14 .47
R13 1K
C20 .47
J2
E1
R1 33
C3 .01
R3 22K *
C4 100 PF *
L3 100
L2 A-4889-2
C8 .01
R5 1.2K
R7 47
Q3 2N3638
L6 100
R15 100
R30 220
R32 150
R19 330
R31 330
C12 .47
R11 1K
C23 .01
R18 1K
C30 .01
L8 1000
C22 .47
R16 47
T1 A-4881-2
C14 .1
C1 .01
Q1 2N3690
C5 3PF
C6 1.5-2.5 PF
Q2 2N4416
C9 .01
R9 82
Q9 2N5457
Q10 2N5457
Q11 2N5457
C13 47 PF
R10 22K
T2 A-4817
R17 68
Q5 2N918
C16 120 PF
Q4 2N3690
R20 39K
C18 .002
C17 220 PF
Y1 7.1 MHz
R21 330
C19 .1
R22 12K
R2 1K
L4 A-4889-2
C7 100 PF *
R4 10K *
R8 200
R6 1.2K *
C2 .01
C10 .01
L1 100
R12 1M
R13 1M
R14 1M
L5 100
C21 .47
R33 6.8K
C2 2.2
R3 100
L5 1000
C4 560 PF
T1 A-4825-2
T2 A-4825-4
CR2 1N270
C8 2.2
R7 470
R18 100
C13 2.2
C9 330 PF
CR1 1N270
R11 390K
R12 390K
U1 3521H
C3 .01
Q1 2N3690
C10 180 PF
C11 20 PF
C12 15 PF
R8 47K
L1 470
C7 39 PF
C15 200PF
C16 47
R14 68K
R10 22M
R13 820K
Q4 2N5457
R22 22M
J3
E1
E1 .01
R1 27
E2
Q2 2N3690
R9 47 K
C22 180 PF
R20 100
C14 2.2
Q3 2N5457
R4 2.2K
R6 27K
R5 2.2K
C5 2.2
C6 2.2

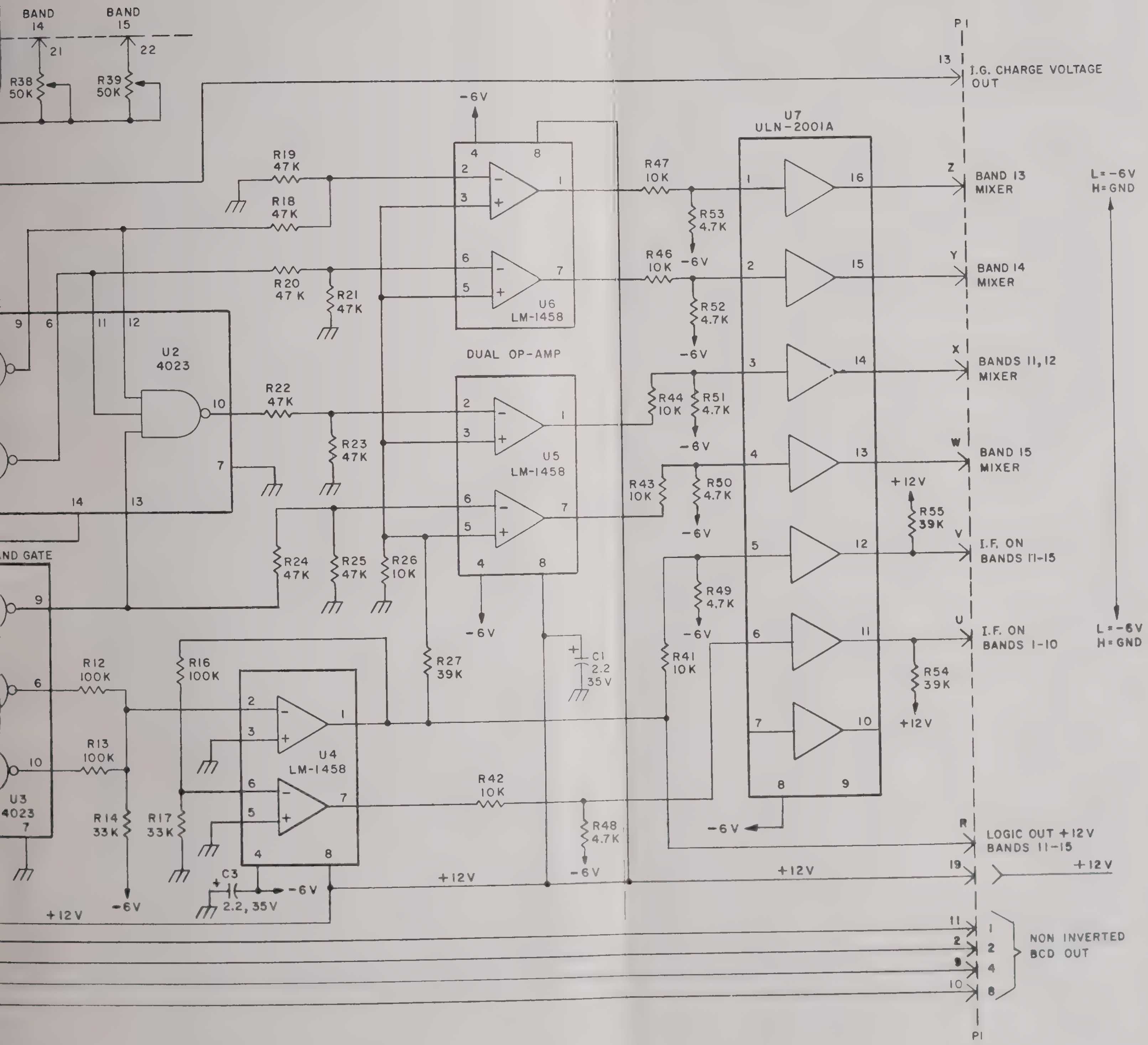


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. ALL COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.

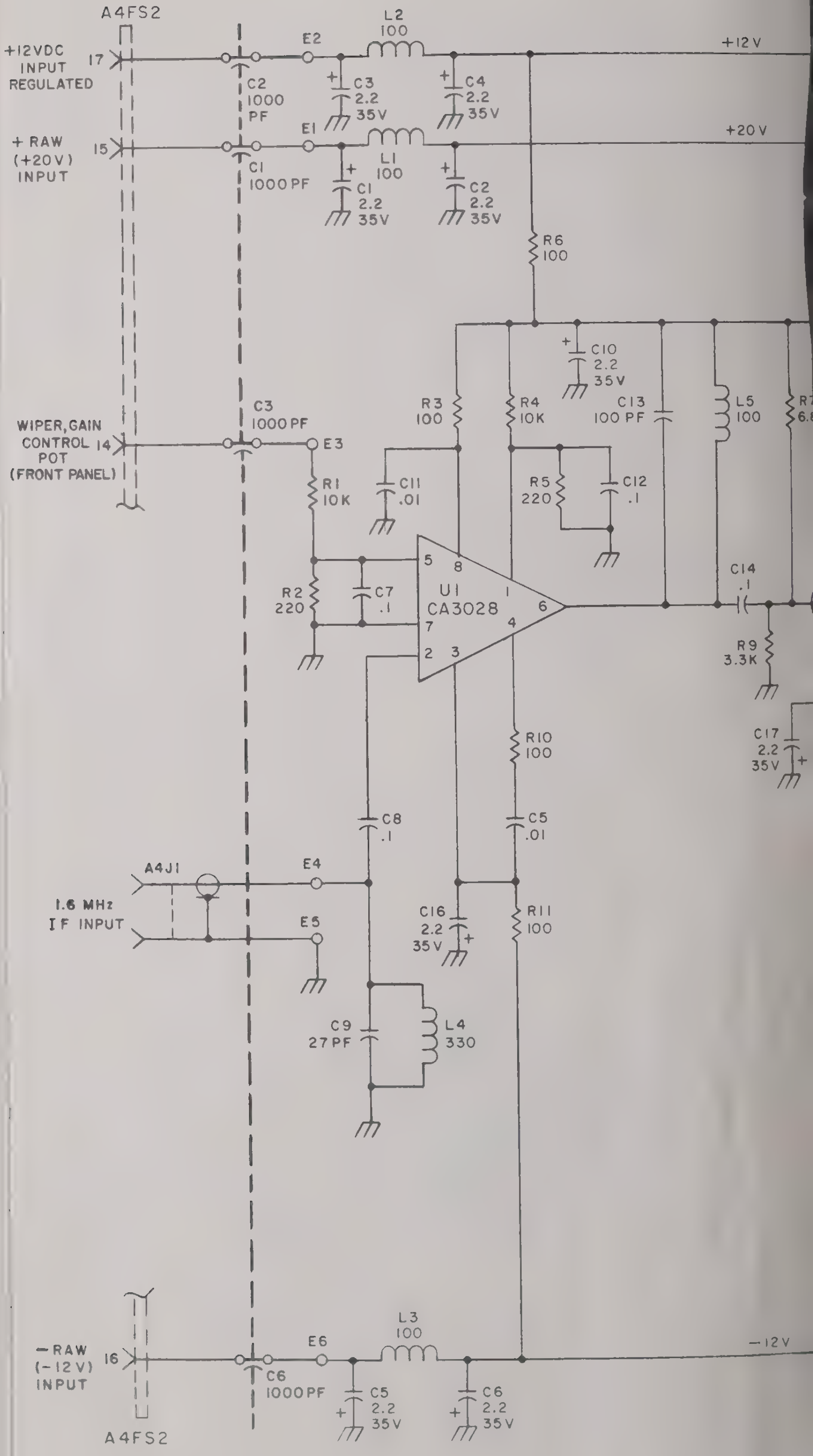
Figure 6.16
IF Amplifier/Discriminator
(A3)

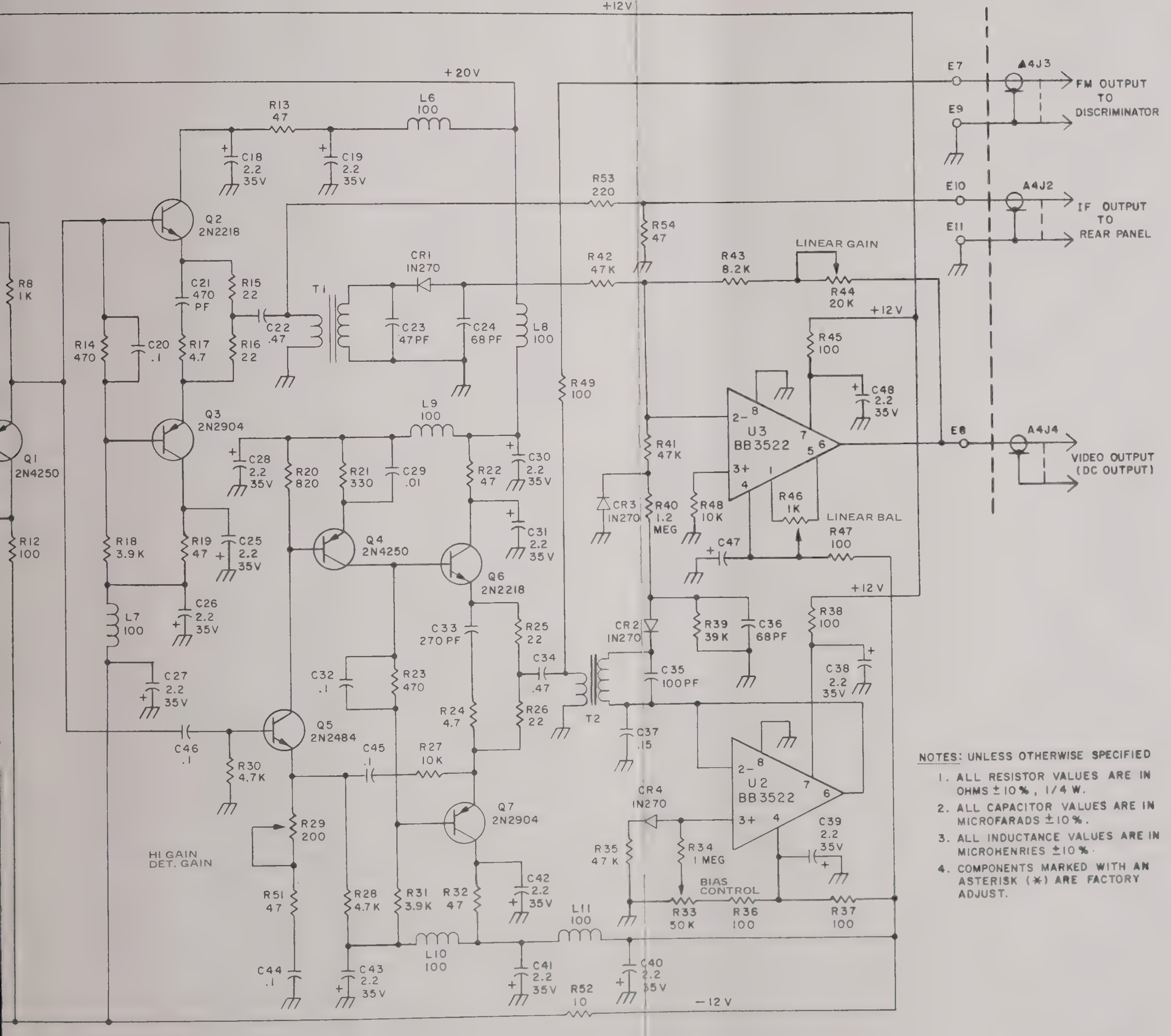

GND
BANDS 1,2,3
BANDS 4,5,6,7
BANDS 8, 9
BAND 10
BANDS 11,12
BAND 13
P1
J,T
12
14
15
16
17
R40 470K
R31 50K
R32 50K
R34 50K
R36 50K
R37 50K
R30 8.2K
R33 8.2K
R35 8.2K
HIGH VOLTAGE IN
1
R28 27K
R29 500K
CR3 1N987
+12V IN
A
R1 100
CR5 1N3064
+12V
C2 2.2 35V
+ RAW
C
R2 390
CR1 1N759
CR2 1N3064
BAND LOGIC COMMON
B
CR4 1N3064
3 INPUT NAND
3 INPUT
+12V
16
E0
15
2 Z̄0
I0 4
3 Z0
7 Z̄1
I1 5
6 Z1
9 Z̄2
I2 11
10 Z2
14 Z̄3
I3 12
13 Z3
U1 34104
8
D
1
R3 1K
R4 10K
E
2
R5 1K
R6 10K
BAND BCD CODE IN
H
4
R7 1K
R8 10K
F
8
R9 1K
R10 10K
S
-6V
R11 100
-6V
P1
1
2
8
3
4
5
1
2
8
3
4
5
11
12
13
14



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (✱) ARE FACTORY ADJUST.

Figure 6.17
IF/MIXER Control Bd
(A6A2)

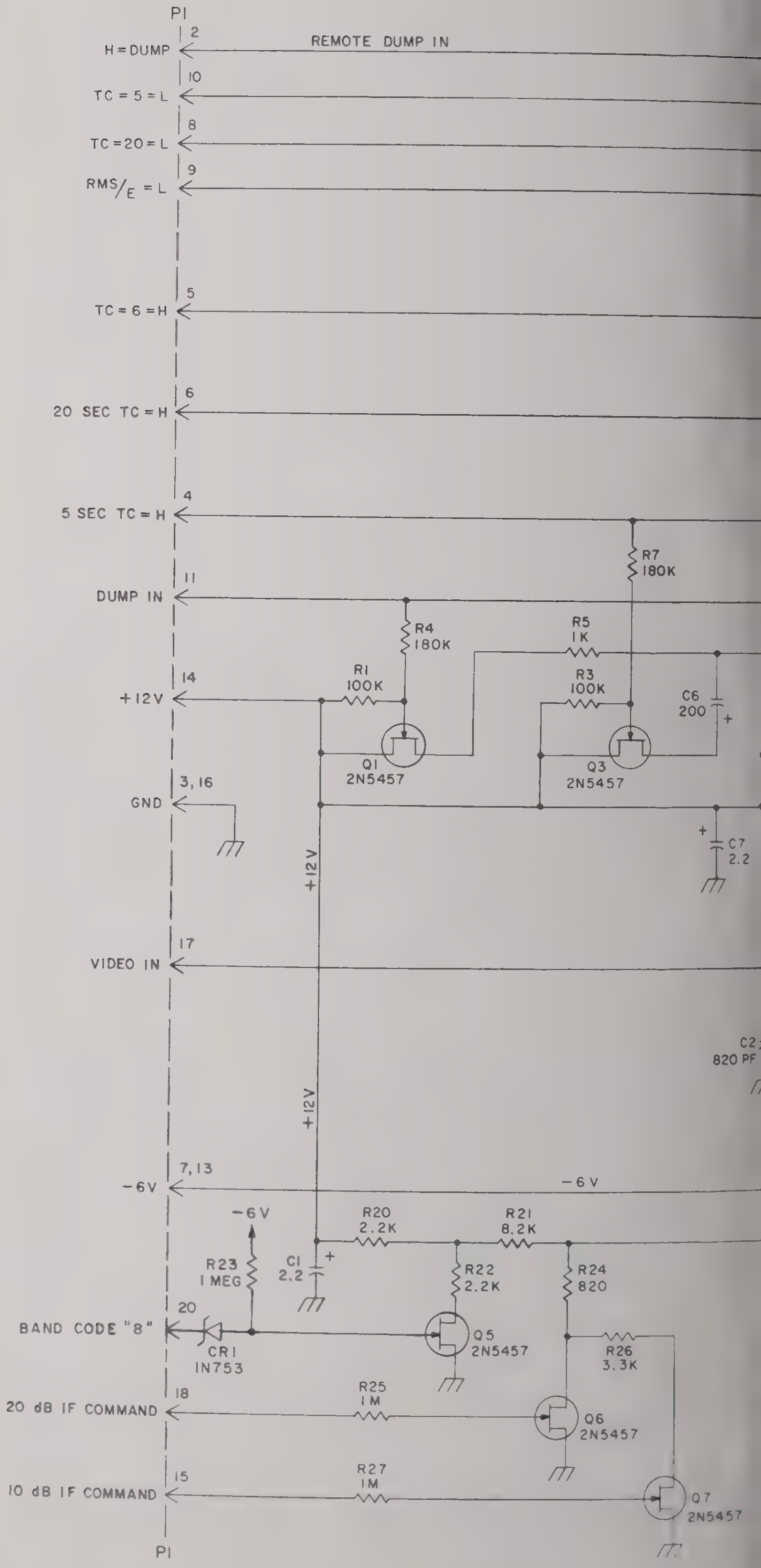

A4FS2
+12VDC INPUT REGULATED
17
+ RAW (+20V) INPUT
15
WIPER, GAIN CONTROL POT (FRONT PANEL)
14
C2 1000 PF
C1 1000 PF
C3 1000 PF
E2
E1
E3
L2 100
L1 100
C3 2.2 35V
C4 2.2 35V
C1 2.2 35V
C2 2.2 35V
+12 V
+20 V
R6 100
C10 2.2 35V
R3 100
R4 10K
C13 100 PF
L5 100
R7 6.8
C11 .01
R5 220
C12 .1
R1 10K
R2 220
C7 .1
U1 CA3028
5
8
1
6
7
4
2
3
C14 .1
R9 3.3K
C17 2.2 35V
R10 100
C5 .01
C8 .1
A4J1
1.6 MHz IF INPUT
E4
E5
C16 2.2 35V
R11 100
C9 27 PF
L4 330
− RAW (−12 V) INPUT
16
A4FS2
C6 1000PF
E6
L3 100
C5 2.2 35V
C6 2.2 35V
−12 V

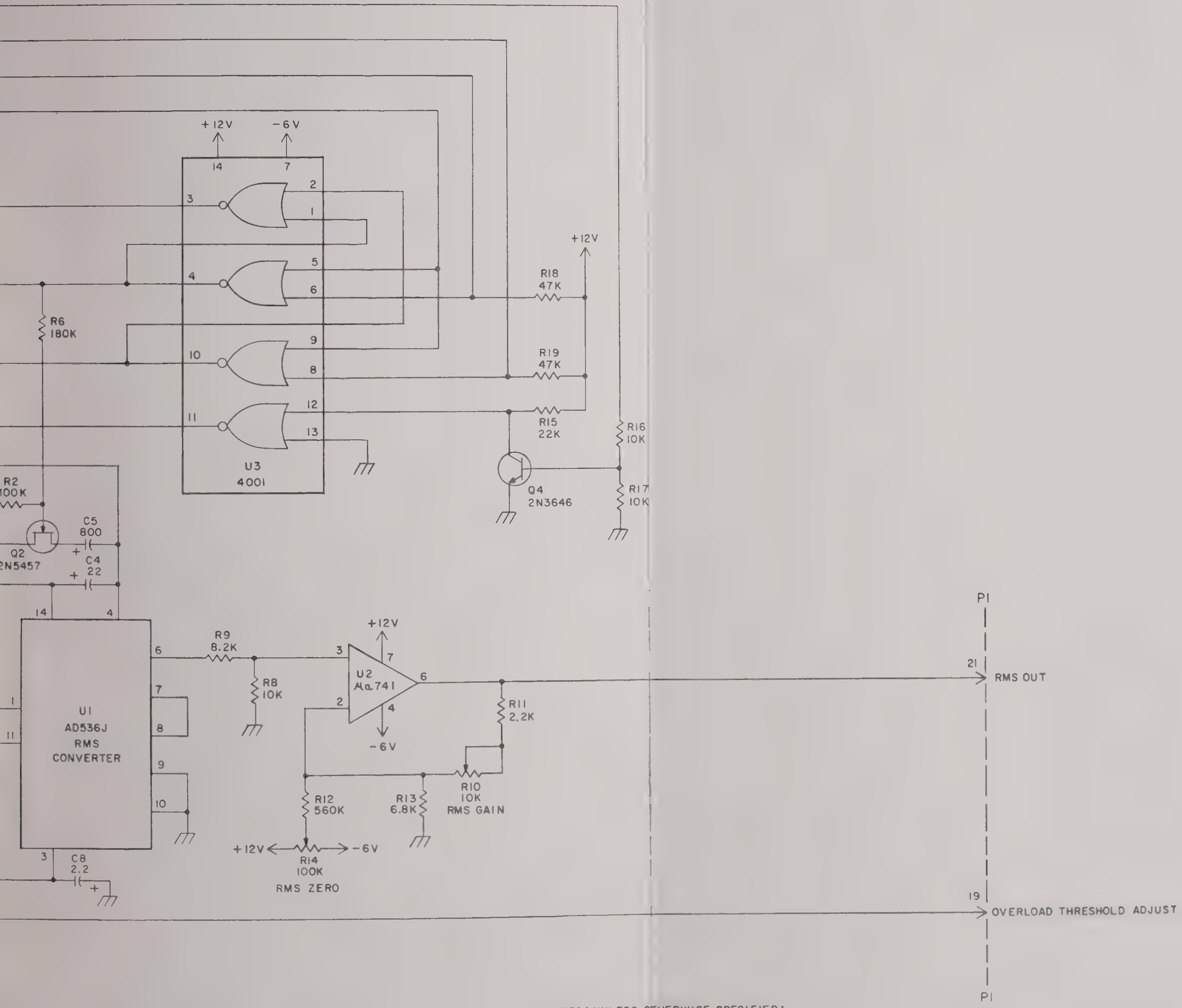


NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS ± 10 %, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10 %.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10 %.
4. COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.18
Linear Detector Bd
(A4A1)

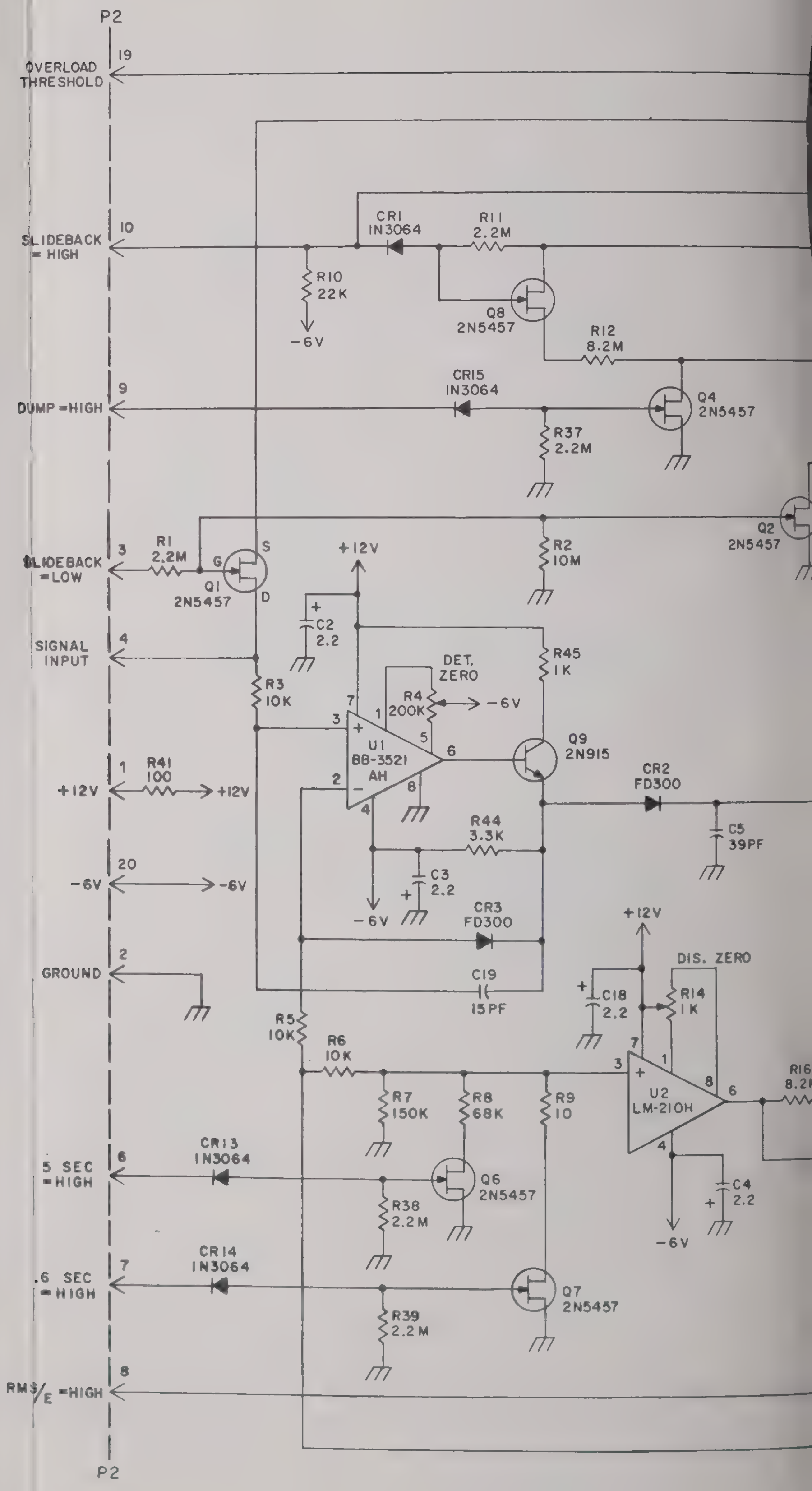

P1
2
H = DUMP
REMOTE DUMP IN
10
TC = 5 = L
8
TC = 20 = L
9
RMS/E = L
5
TC = 6 = H
6
20 SEC TC = H
4
5 SEC TC = H
R7
180K
11
DUMP IN
R4
180K
R5
1K
R1
100K
R3
100K
C6
200
+
14
+12V
Q1
2N5457
Q3
2N5457
3, 16
GND
+
C7
2.2
+12V
17
VIDEO IN
C2
820 PF
+12V
7, 13
-6V
-6 V
-6 V
R20
2.2K
R21
8.2K
R23
1 MEG
C1
2.2
+
R22
2.2K
R24
820
20
BAND CODE "8"
CR1
1N753
Q5
2N5457
R26
3.3K
18
20 dB IF COMMAND
R25
1 M
Q6
2N5457
15
10 dB IF COMMAND
R27
1M
Q7
2N5457
P1

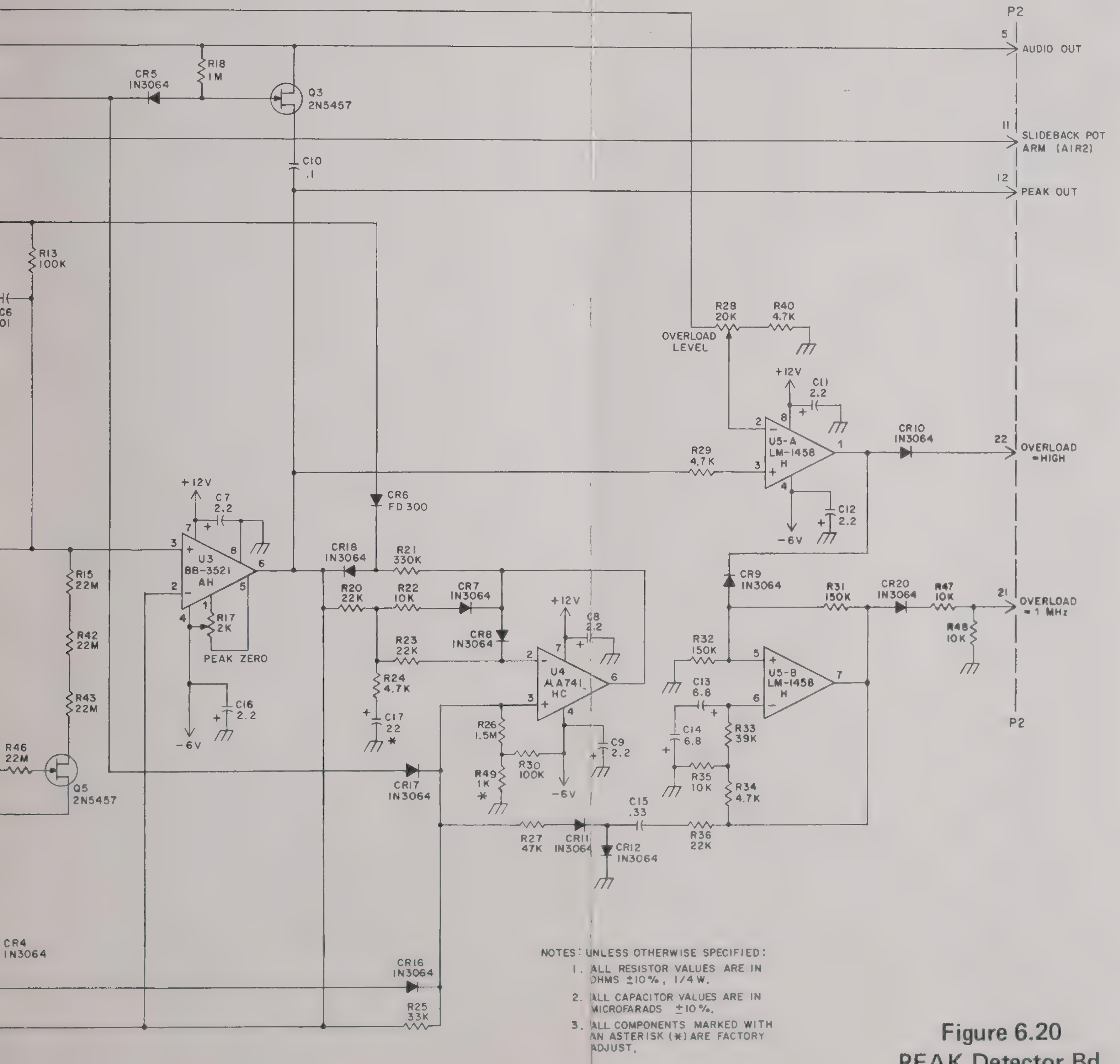


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (✱) ARE FACTORY ADJUST.

Figure 6.19
RMS Detector Bd
(A7A1A1)

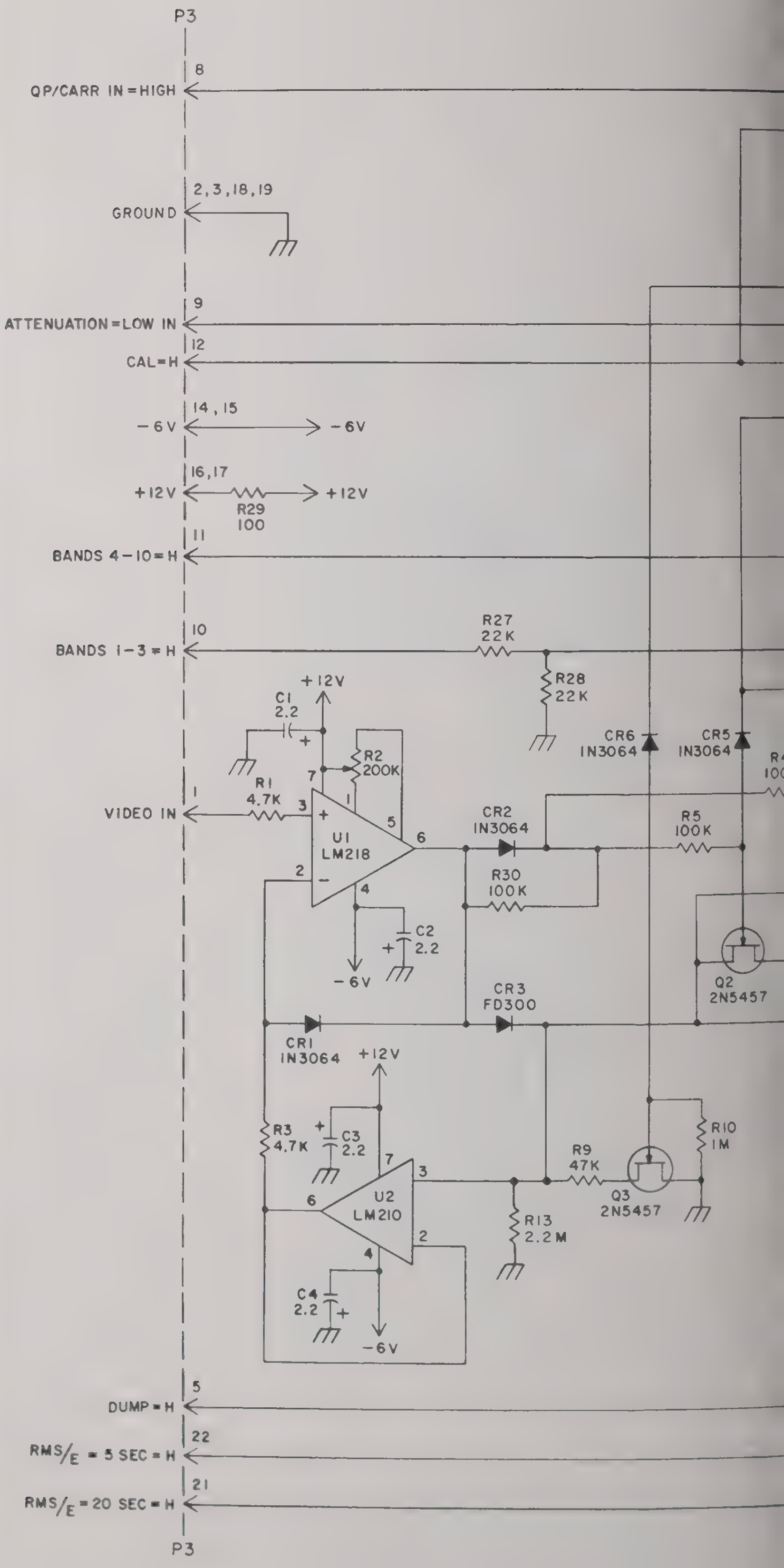

P2
OVERLOAD THRESHOLD
19
SLIDEBACK = HIGH
10
CR1
1N3064
R11
2.2M
R10
22K
-6V
Q8
2N5457
R12
8.2M
DUMP = HIGH
9
CR15
1N3064
Q4
2N5457
R37
2.2M
Q2
2N5457
SLIDEBACK = LOW
3
R1
2.2M
G
S
D
Q1
2N5457
+12V
R2
10M
C2
2.2
SIGNAL INPUT
4
R45
1K
DET. ZERO
R3
10K
R4
200K
-6V
U1
BB-3521
AH
Q9
2N915
+12V
1
R41
100
+12V
CR2
FD300
C5
39PF
R44
3.3K
-6V
20
-6V
C3
2.2
-6V
CR3
FD300
+12V
GROUND
2
C19
15PF
DIS. ZERO
C18
2.2
R14
1K
R5
10K
R6
10K
R7
150K
R8
68K
R9
10
U2
LM-210H
R16
8.2
C4
2.2
-6V
5 SEC = HIGH
6
CR13
1N3064
Q6
2N5457
R38
2.2M
.6 SEC = HIGH
7
CR14
1N3064
Q7
2N5457
R39
2.2M
RMS/E = HIGH
8
P2

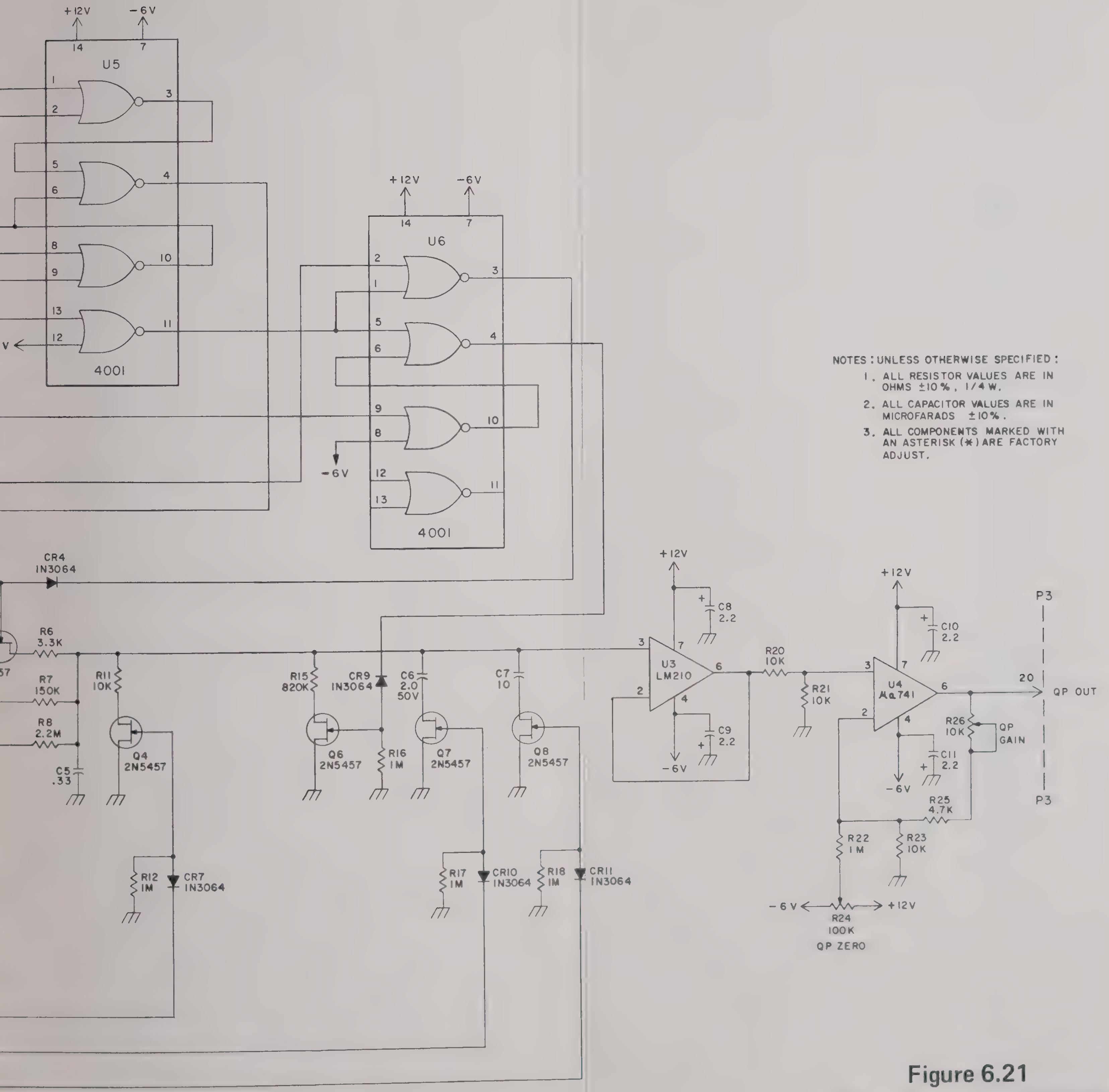


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.20
PEAK Detector Bd
(A7A1A2)

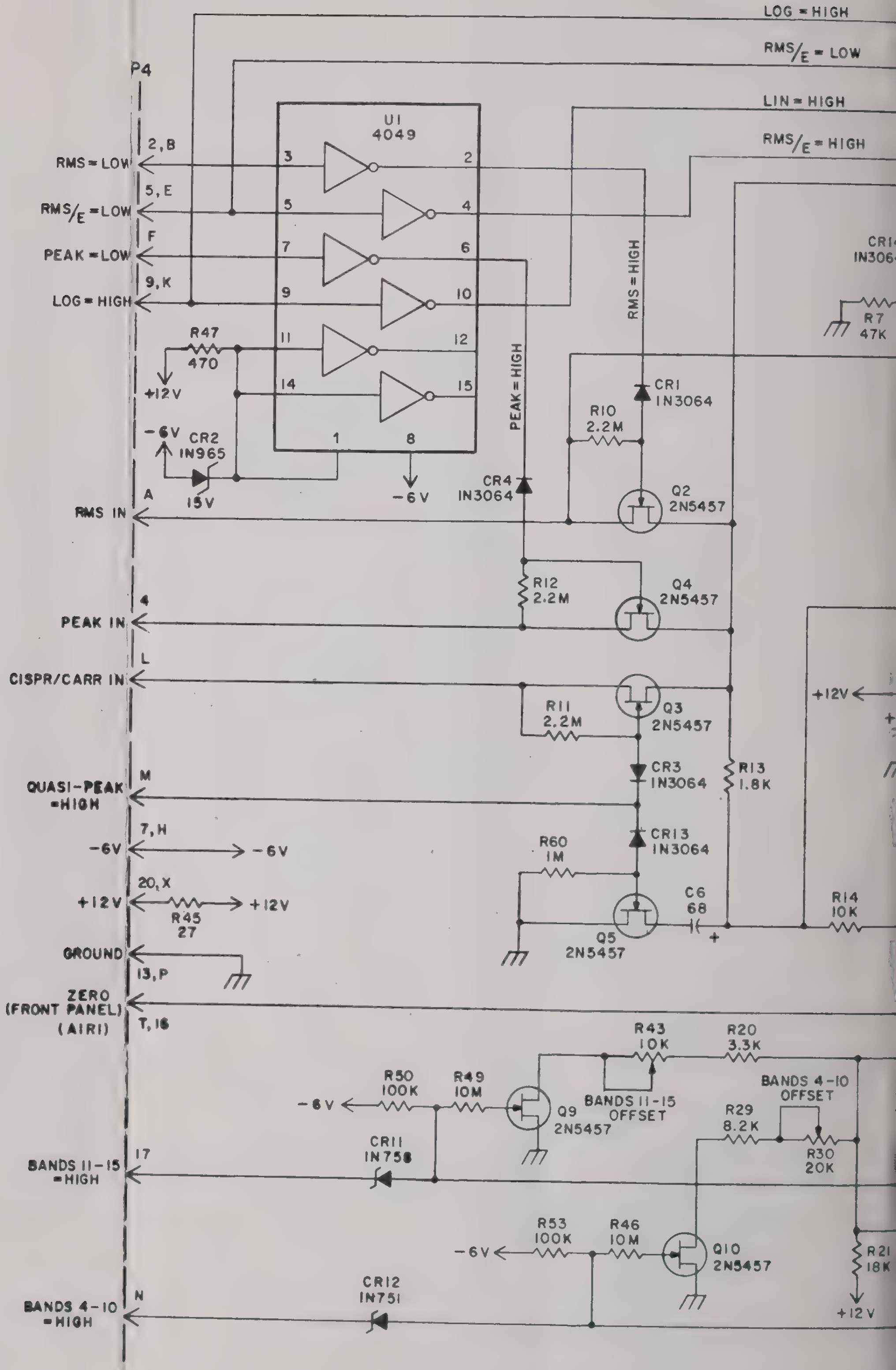

P3
8
QP/CARR IN = HIGH
2,3,18,19
GROUND
9
ATTENUATION = LOW IN
12
CAL = H
14, 15
− 6V
− 6V
16, 17
+12V
R29
100
+12V
11
BANDS 4 − 10 = H
10
BANDS 1 − 3 = H
R27
22K
R28
22K
+12V
C1
2.2
R2
200K
R1
4.7K
VIDEO IN
U1
LM218
C2
2.2
− 6V
CR6
1N3064
CR5
1N3064
CR2
1N3064
R5
100K
R30
100K
Q2
2N5457
CR3
FD300
CR1
1N3064
+12V
R3
4.7K
C3
2.2
U2
LM210
C4
2.2
− 6V
R13
2.2M
R9
47K
Q3
2N5457
R10
1M
5
DUMP = H
22
RMS/E = 5 SEC = H
21
RMS/E = 20 SEC = H
P3

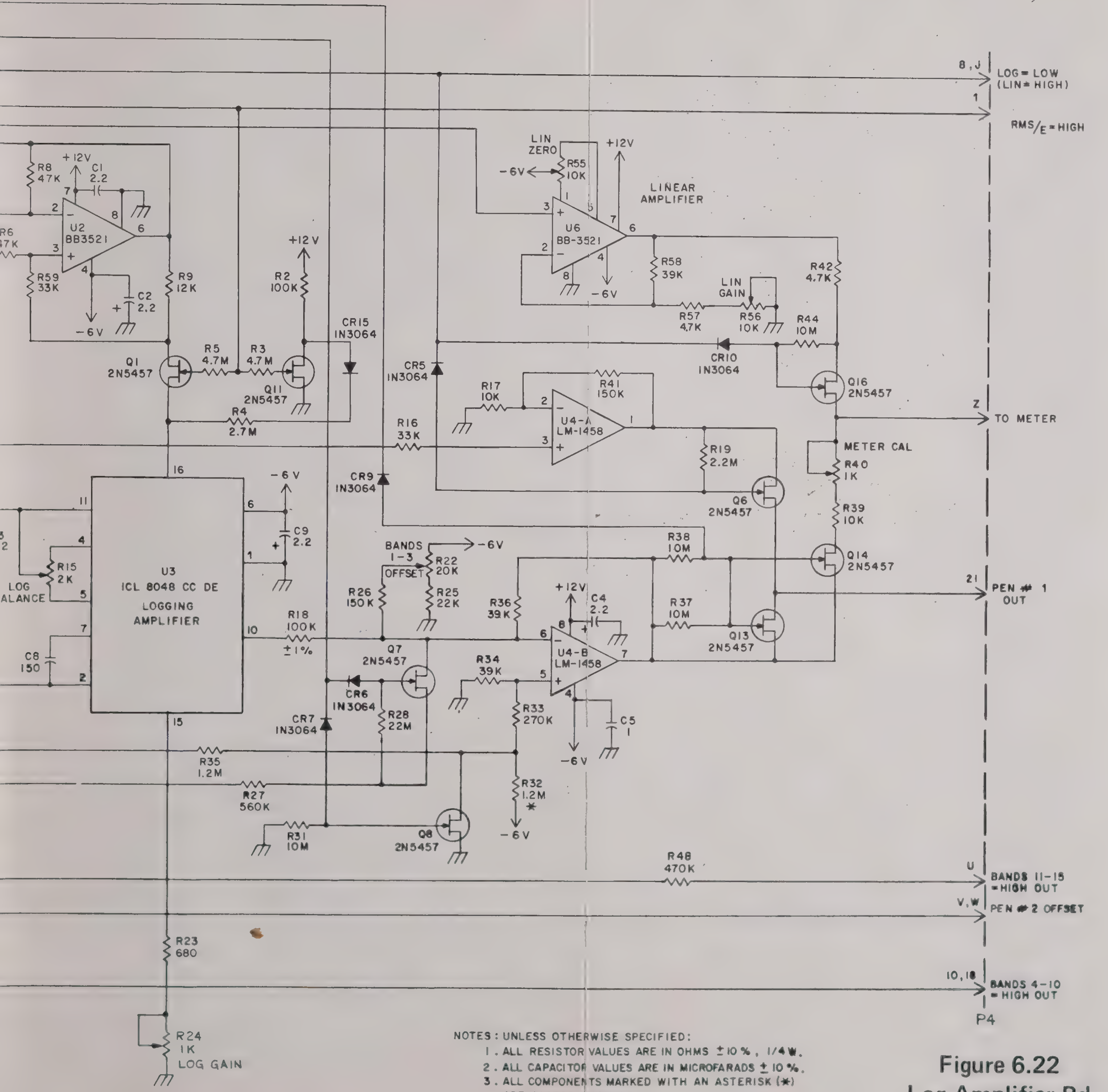


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

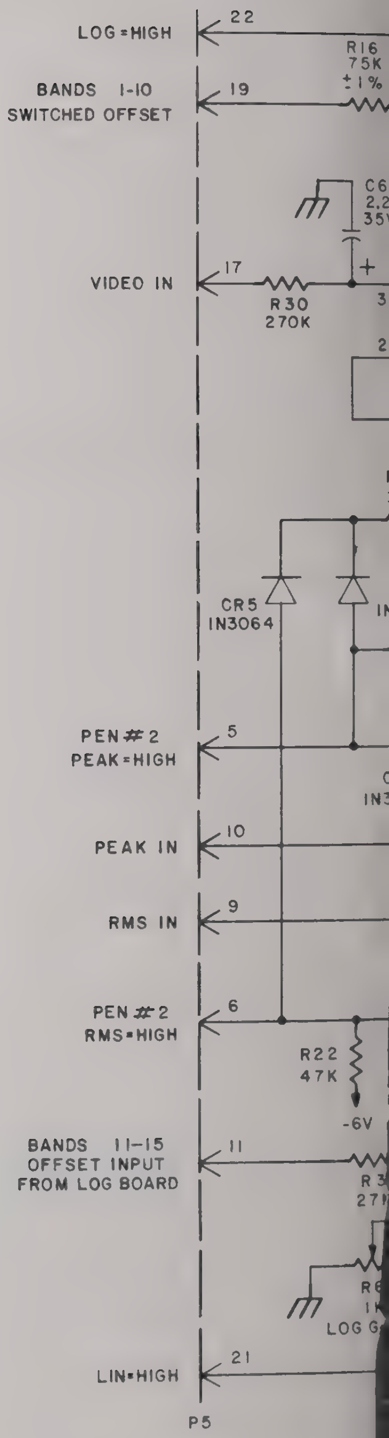
Figure 6.21
QUASI-PEAK/CARRIER
Detector Bd (A7A1A3)

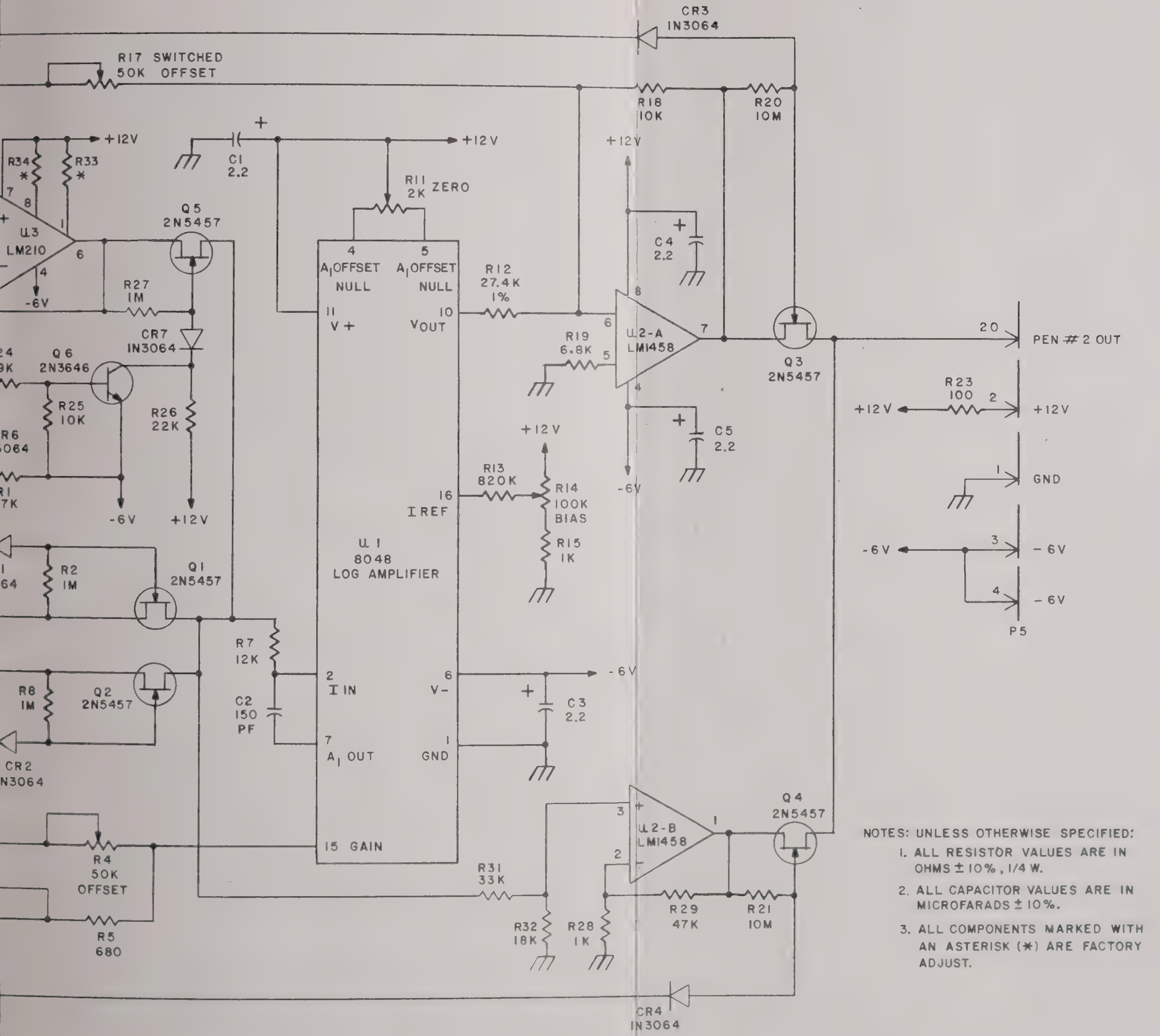

LOG = HIGH
RMS/E = LOW
LIN = HIGH
RMS/E = HIGH
P4
U1
4049
2,B
RMS = LOW
5,E
RMS/E = LOW
F
PEAK = LOW
9,K
LOG = HIGH
3
2
5
4
7
6
9
10
11
12
14
15
1
8
R47
470
+12V
-6V
CR2
1N965
15V
-6V
RMS = HIGH
PEAK = HIGH
CR1
1N3064
R10
2.2M
CR4
1N3064
A
RMS IN
Q2
2N5457
R12
2.2M
Q4
2N5457
4
PEAK IN
L
CISPR/CARR IN
R11
2.2M
Q3
2N5457
CR3
1N3064
R13
1.8K
M
QUASI-PEAK =HIGH
7,H
-6V
-6V
CR13
1N3064
R60
1M
20,X
+12V
R45
27
+12V
C6
68
Q5
2N5457
R14
10K
+12V
GROUND
13,P
ZERO (FRONT PANEL) (AIRI)
T,16
R43
10K
R20
3.3K
BANDS 4-10 OFFSET
R50
100K
R49
10M
-6V
Q9
2N5457
BANDS 11-15 OFFSET
R29
8.2K
R30
20K
CR11
1N758
17
BANDS 11-15 =HIGH
R53
100K
R46
10M
-6V
Q10
2N5457
R21
18K
+12V
CR12
1N751
N
BANDS 4-10 =HIGH
CR1
1N306
R7
47K



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.22
Log Amplifier Bd
(A7A1A4)

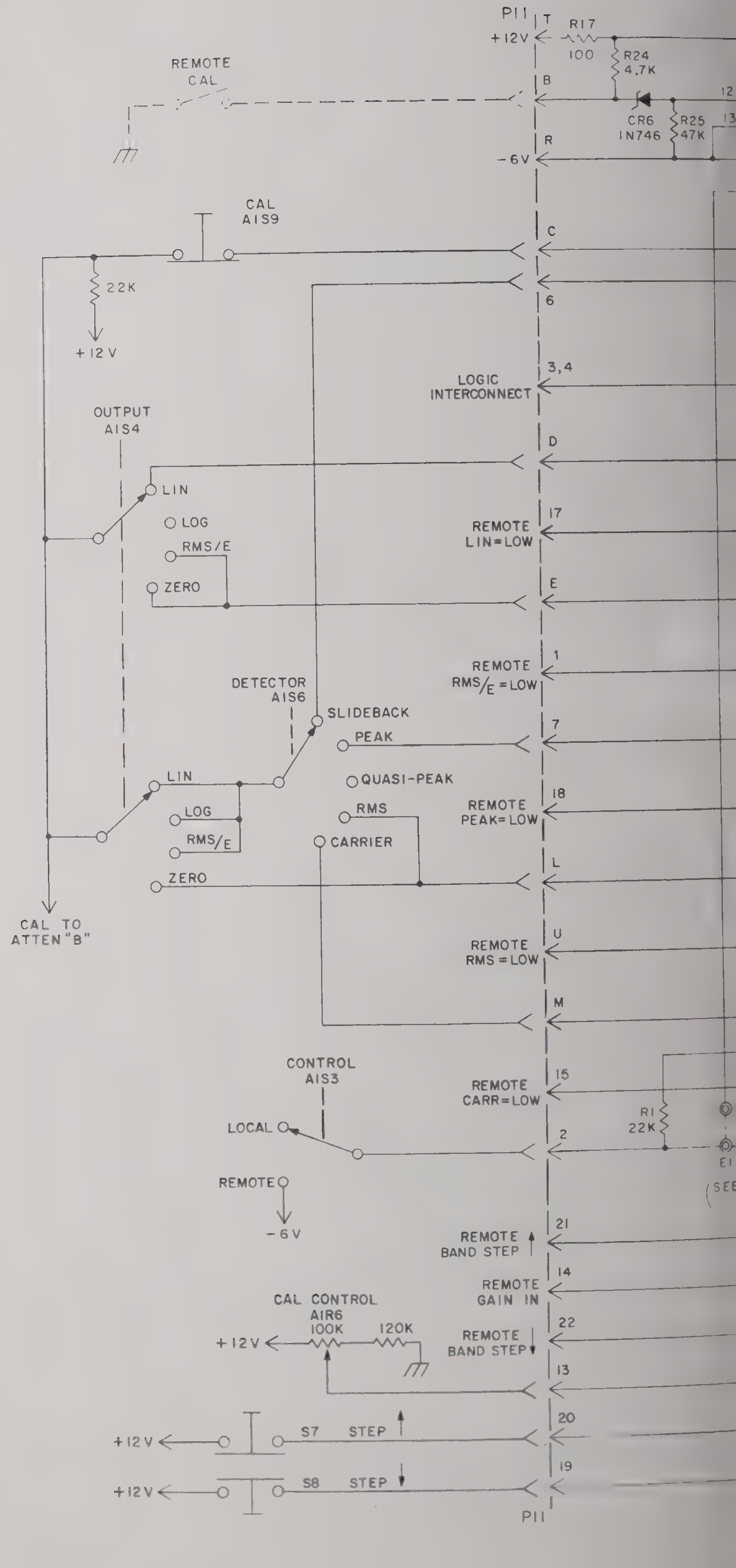

LOG=HIGH
22
BANDS 1-10
SWITCHED OFFSET
19
R16
75K
±1%
C6
2.2
35V
VIDEO IN
17
R30
270K
+
3
2
CR5
IN3064
IN
PEN #2
PEAK=HIGH
5
IN3
PEAK IN
10
RMS IN
9
PEN #2
RMS=HIGH
6
R22
47K
-6V
BANDS 11-15
OFFSET INPUT
FROM LOG BOARD
11
R3
27
R6
1K
LOG G
LIN=HIGH
21
P5

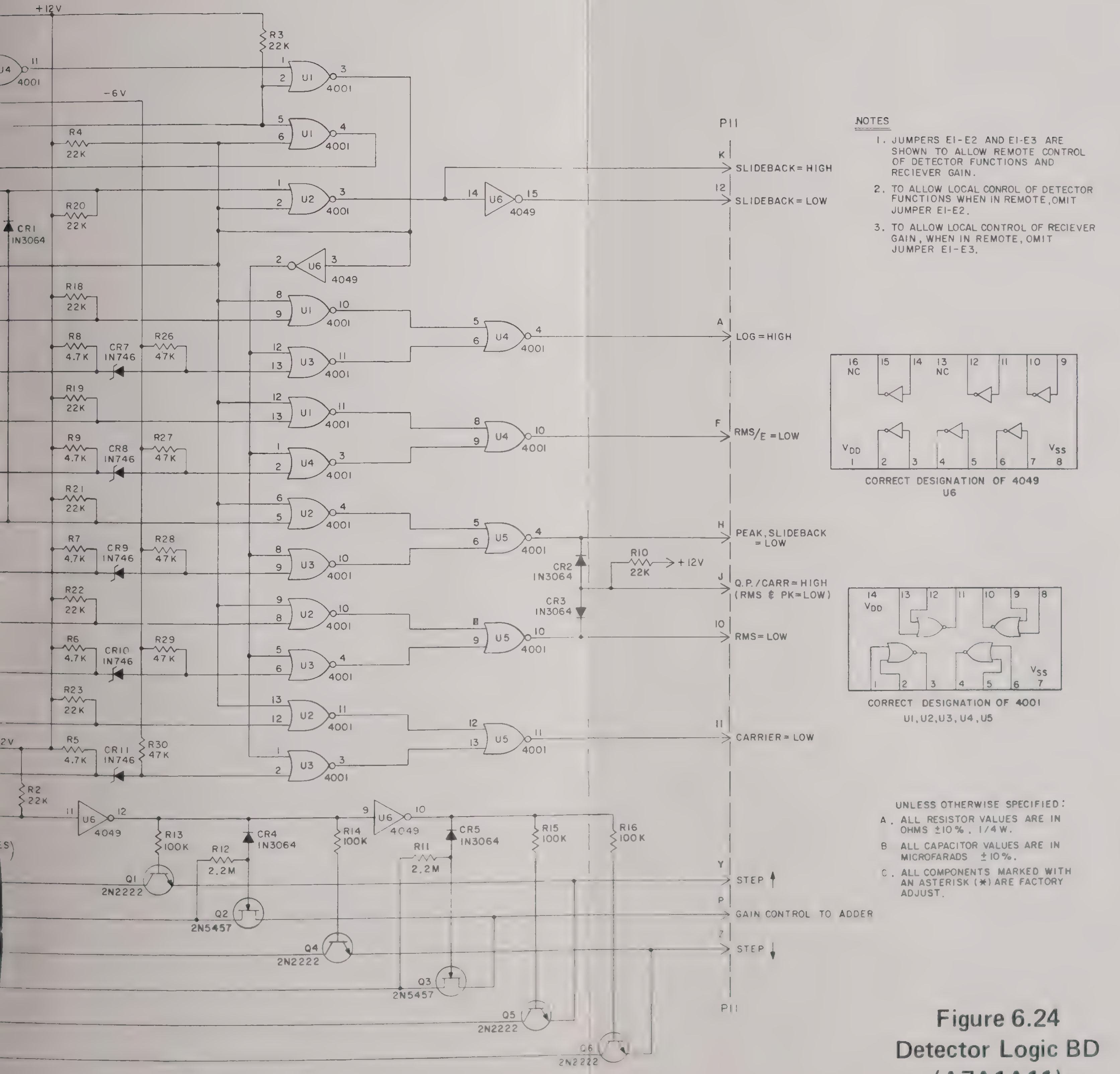


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.23
Pen #2 Driver BD
(A7A1A5)


P11
T
R17
100
+12V
R24
4.7K
REMOTE
CAL
B
CR6
1N746
R25
47K
12
13
R
-6V
CAL
A1S9
C
22K
+12V
6
3,4
LOGIC
INTERCONNECT
OUTPUT
A1S4
D
LIN
LOG
17
REMOTE
LIN=LOW
RMS/E
ZERO
E
1
REMOTE
RMS/E=LOW
DETECTOR
A1S6
SLIDEBACK
7
PEAK
LIN
QUASI-PEAK
18
LOG
RMS
REMOTE
PEAK=LOW
RMS/E
CARRIER
L
ZERO
CAL TO
ATTEN "B"
U
REMOTE
RMS=LOW
M
CONTROL
A1S3
15
REMOTE
CARR=LOW
R1
22K
LOCAL
2
E1
(SEE
REMOTE
-6V
21
REMOTE
BAND STEP ↑
14
REMOTE
GAIN IN
CAL CONTROL
A1R6
100K
120K
+12V
22
REMOTE
BAND STEP ↓
13
20
+12V
S7
STEP ↑
19
+12V
S8
STEP ↓
P11



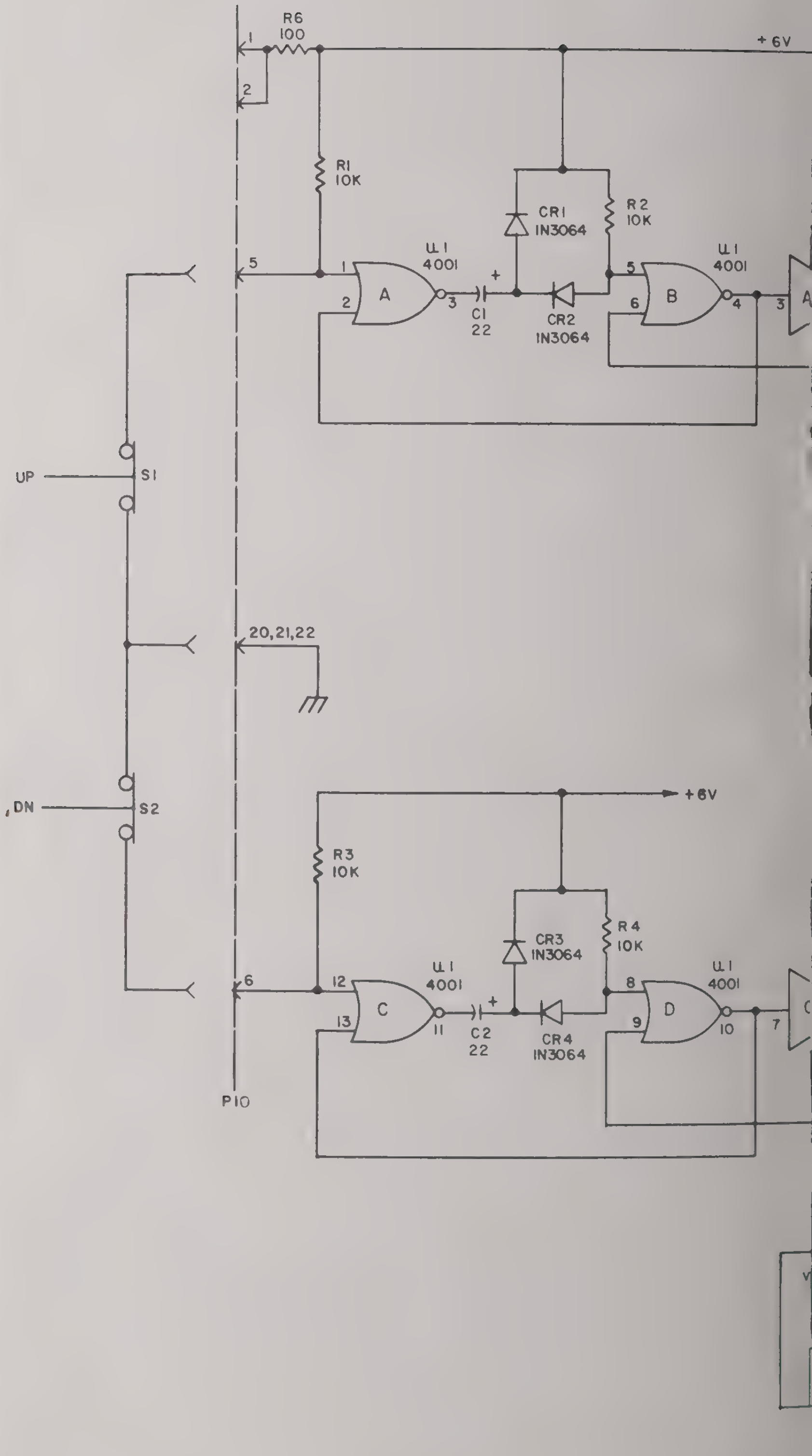
NOTES

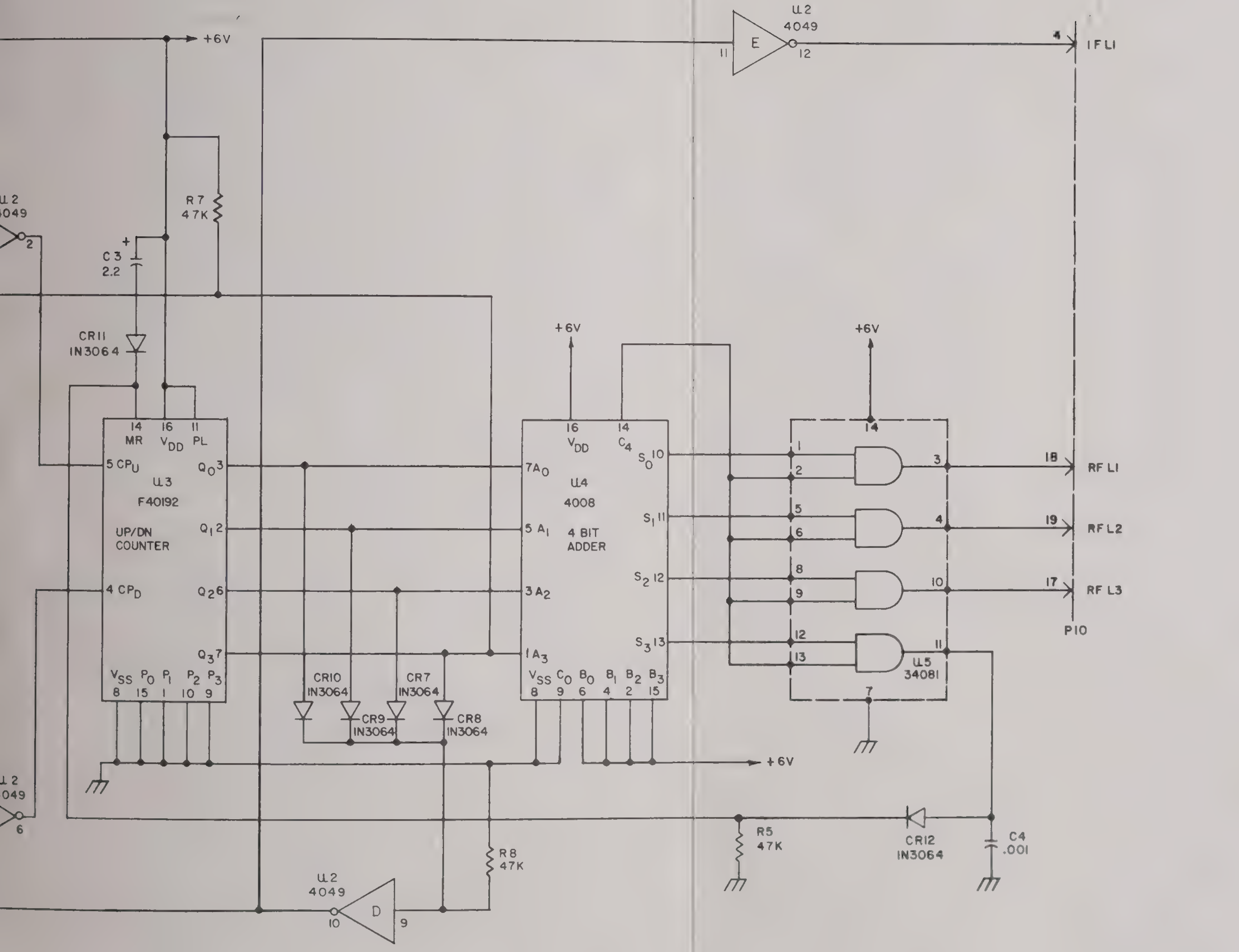
1. JUMPERS E1-E2 AND E1-E3 ARE SHOWN TO ALLOW REMOTE CONTROL OF DETECTOR FUNCTIONS AND RECIEVER GAIN.
2. TO ALLOW LOCAL CONROL OF DETECTOR FUNCTIONS WHEN IN REMOTE, OMIT JUMPER E1-E2.
3. TO ALLOW LOCAL CONTROL OF RECIEVER GAIN, WHEN IN REMOTE, OMIT JUMPER E1-E3.

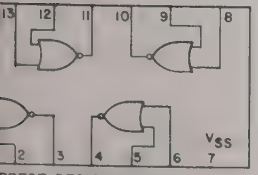
UNLESS OTHERWISE SPECIFIED:

A. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
B. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
C. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

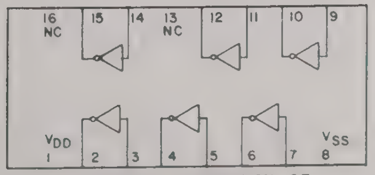
Figure 6.24
Detector Logic BD
(A7A1A11)


R6
100
+6V
1
2
R1
10K
CR1
IN3064
R2
10K
U1
4001
5
1
2
A
3
C1
22
+
CR2
IN3064
5
6
B
4
3
A
UP
S1
20,21,22
,DN
S2
+6V
R3
10K
CR3
IN3064
R4
10K
U1
4001
6
12
13
C
11
+
C2
22
CR4
IN3064
8
9
D
10
7
P10





RRECT DESIGNATION OF
U1 4001

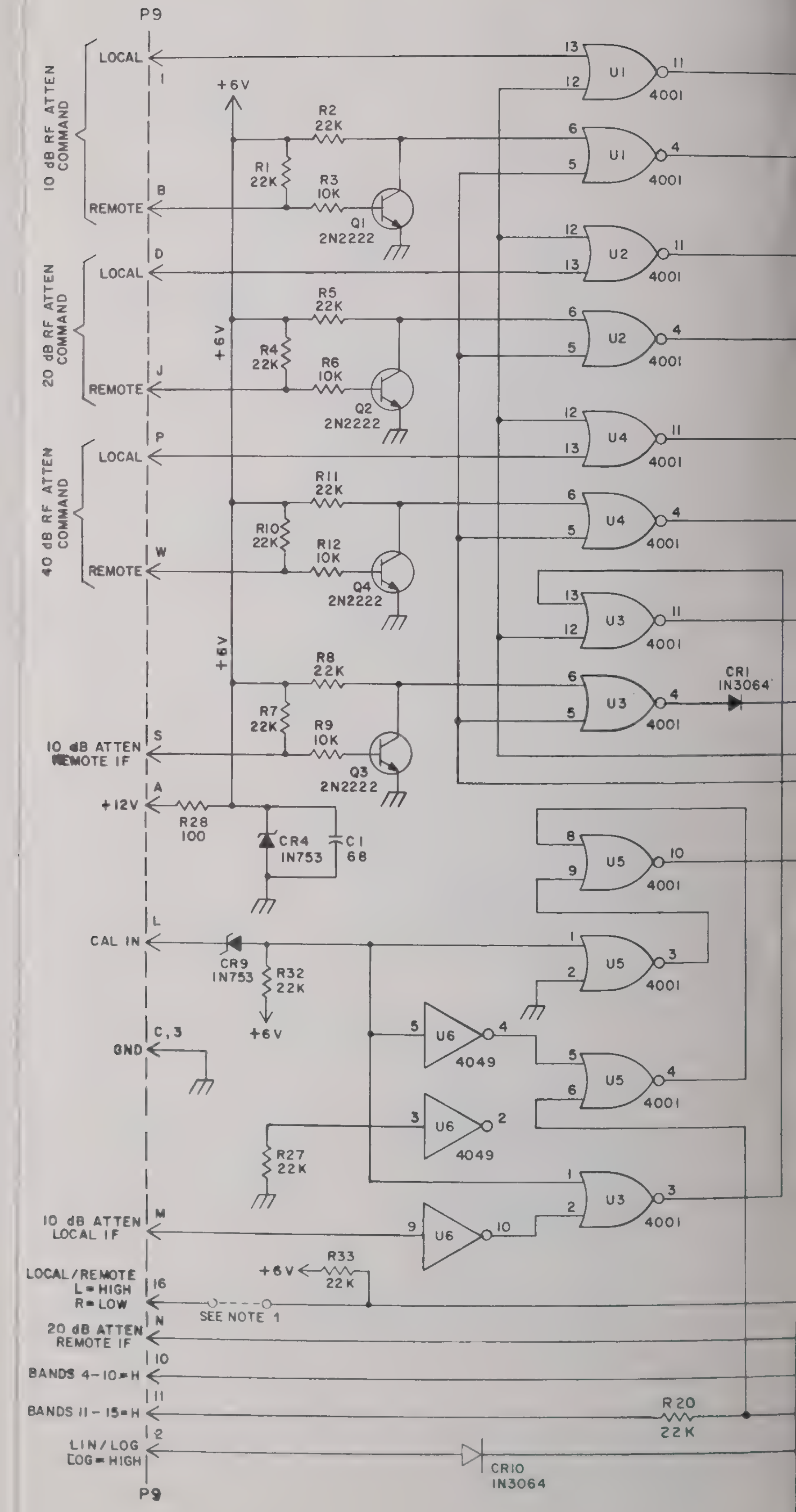


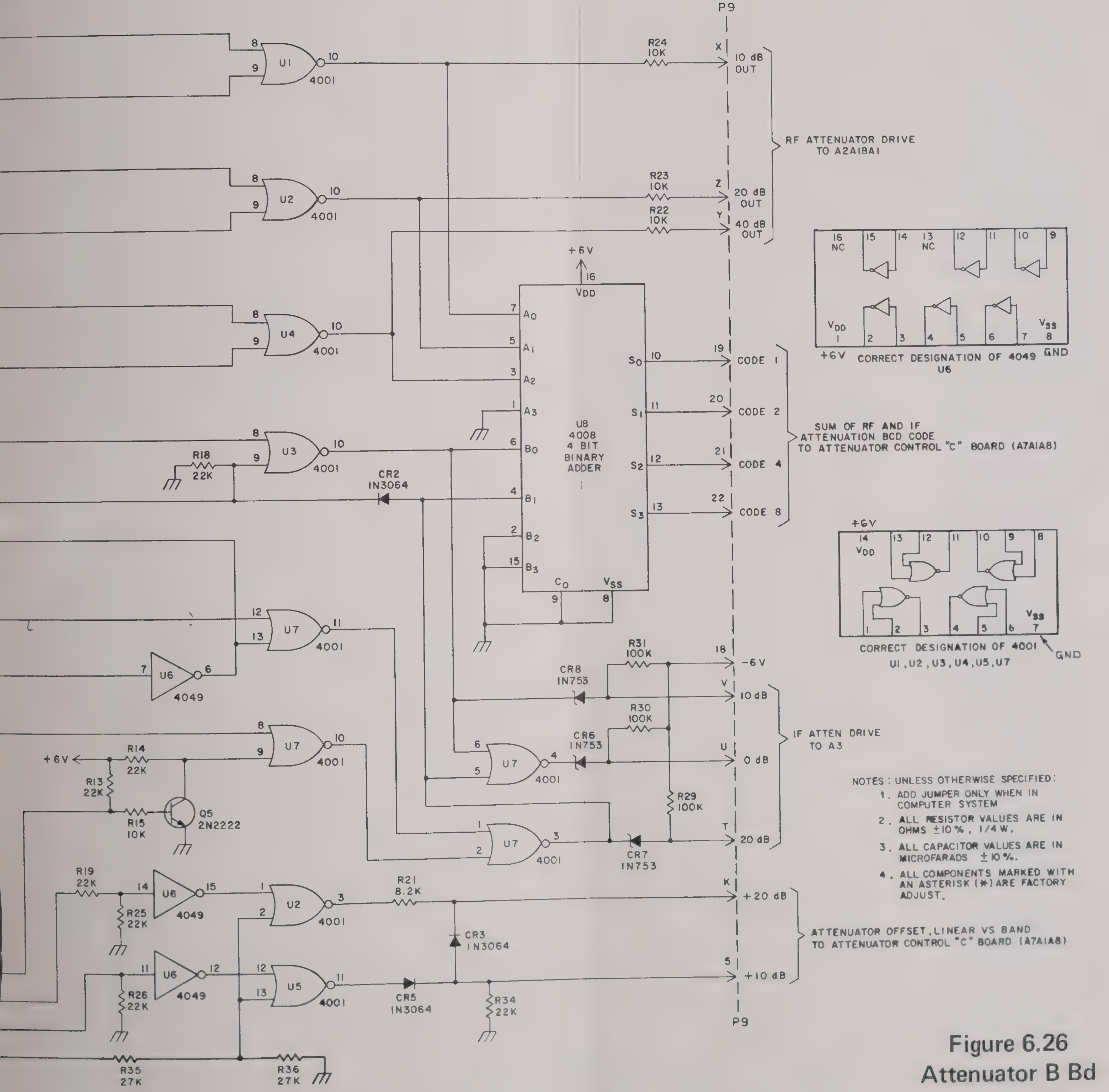
CORRECT DESIGNATION OF
U2 4049

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%.

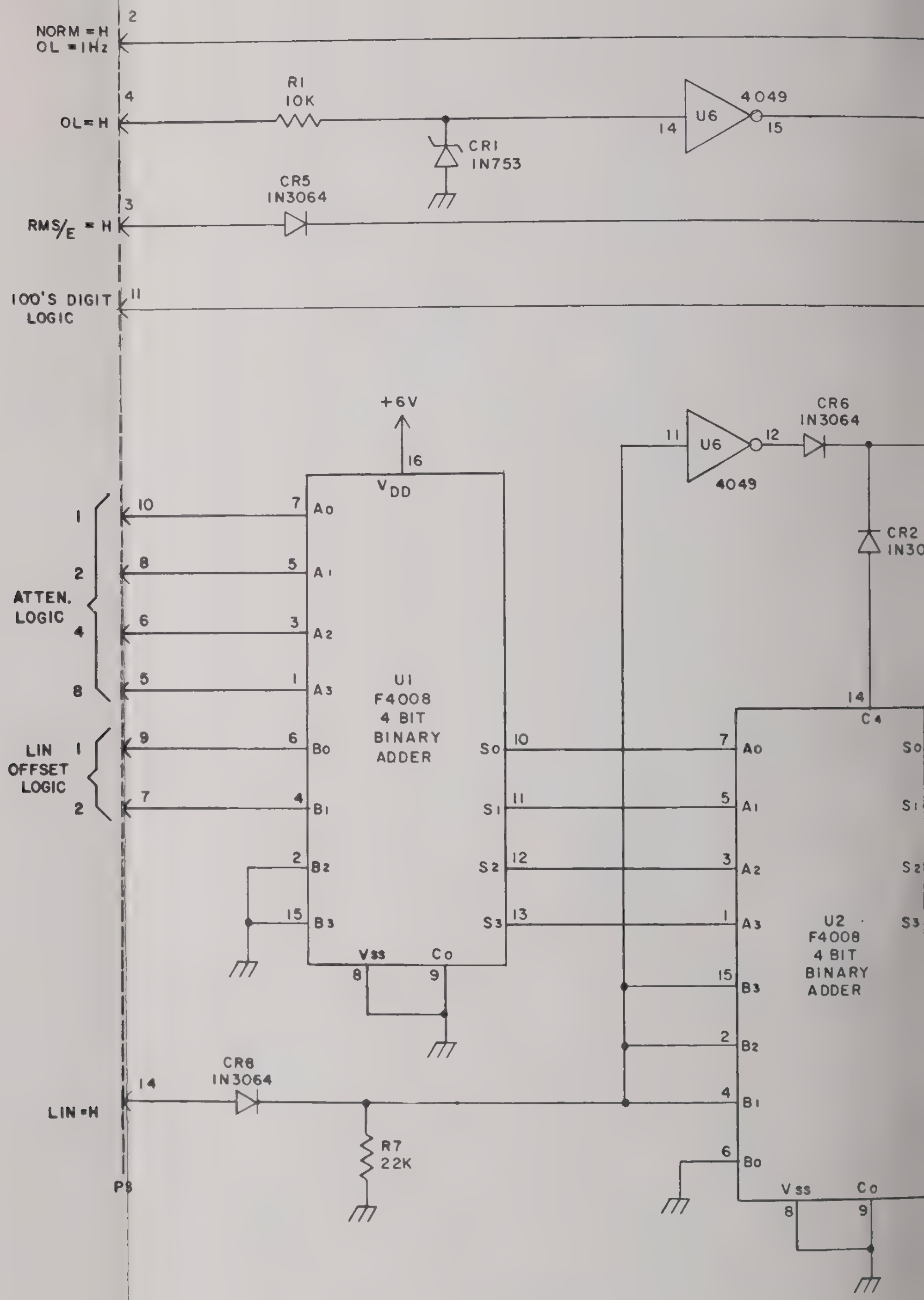
Figure 6.25
Attenuator A BD
(A7A1A10)

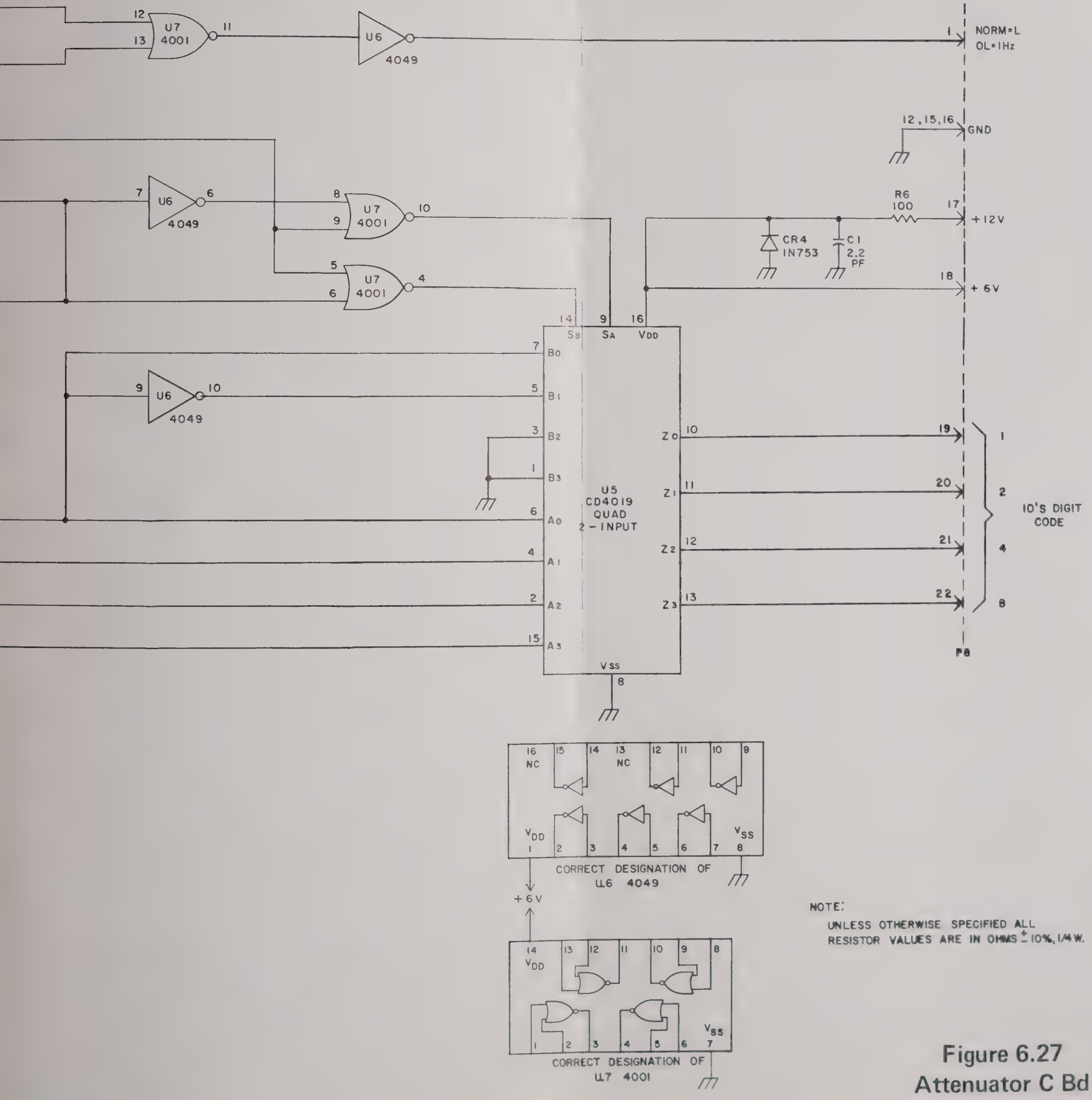

P9
10 dB RF ATTEN COMMAND
LOCAL
1
REMOTE
B
20 dB RF ATTEN COMMAND
LOCAL
D
REMOTE
J
40 dB RF ATTEN COMMAND
LOCAL
P
REMOTE
W
10 dB ATTEN REMOTE IF
S
+12V
A
CAL IN
L
GND
C, 3
10 dB ATTEN LOCAL IF
M
LOCAL/REMOTE L=HIGH R=LOW
16
SEE NOTE 1
20 dB ATTEN REMOTE IF
N
BANDS 4-10=H
10
BANDS 11-15=H
11
LIN/LOG LOG=HIGH
2
P9
+6V
R1 22K
R2 22K
R3 10K
Q1 2N2222
R4 22K
R5 22K
R6 10K
Q2 2N2222
R10 22K
R11 22K
R12 10K
Q4 2N2222
R7 22K
R8 22K
R9 10K
Q3 2N2222
R28 100
CR4 IN753
C1 68
CR9 IN753
R32 22K
R27 22K
R33 22K
R20 22K
CR10 IN3064
CR1 IN3064
U1 4001
U2 4001
U3 4001
U4 4001
U5 4001
U6 4049
1
2
3
4
5
6
8
9
10
11
12
13



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ADD JUMPER ONLY WHEN IN COMPUTER SYSTEM
2. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
4. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

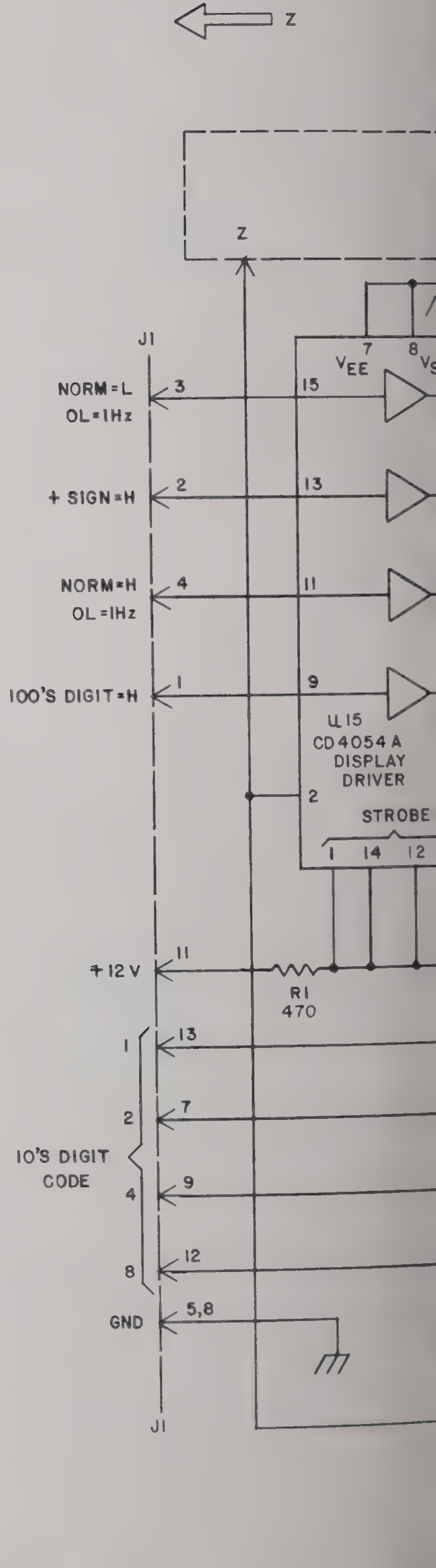
Figure 6.26
Attenuator B Bd
(A7A1A9)

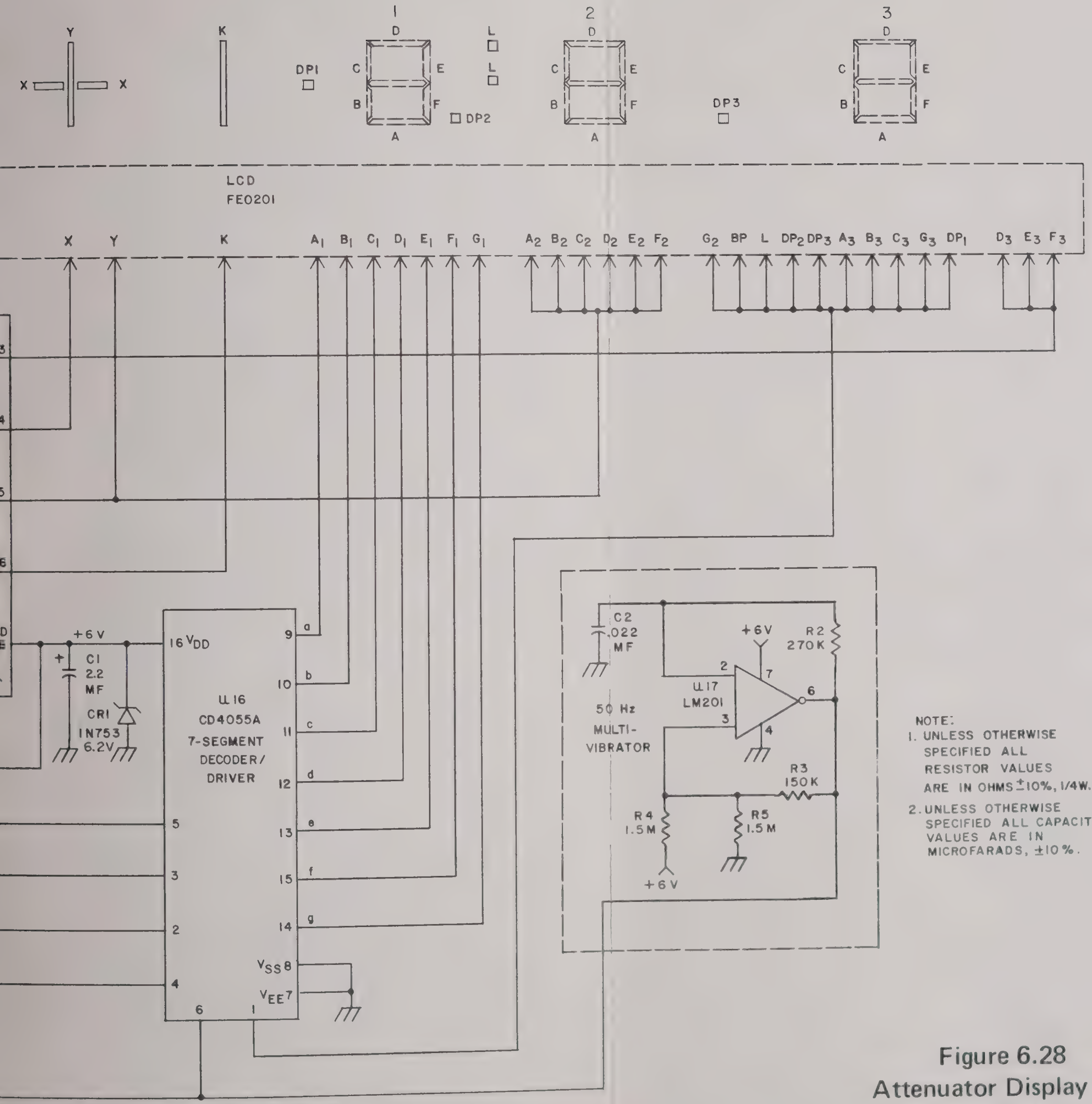

NORM = H
OL = 1Hz
OL = H
RMS/E = H
100'S DIGIT LOGIC
ATTEN. LOGIC
1
2
4
8
LIN OFFSET LOGIC
1
2
LIN = H
P8
R1
10K
CR1
1N753
CR5
1N3064
U6
4049
CR6
1N3064
CR2
+6V
VDD
U1
F4008
4 BIT
BINARY
ADDER
A0
A1
A2
A3
B0
B1
B2
B3
S0
S1
S2
S3
Vss
Co
C4
U2
F4008
4 BIT
BINARY
ADDER
CR8
1N3064
R7
22K



NOTE:
UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4 W.

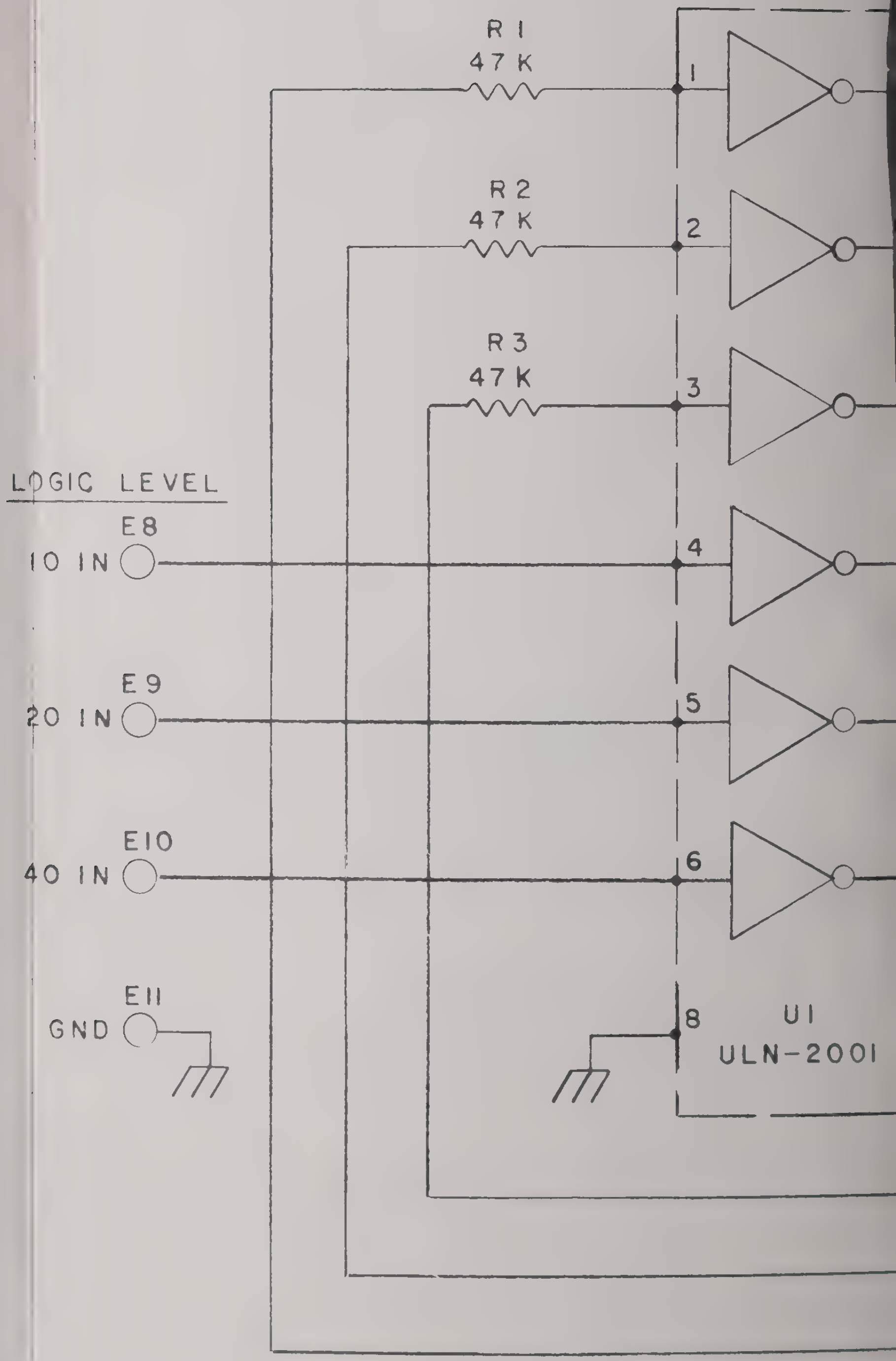
Figure 6.27
Attenuator C Bd
(A7A1A8)

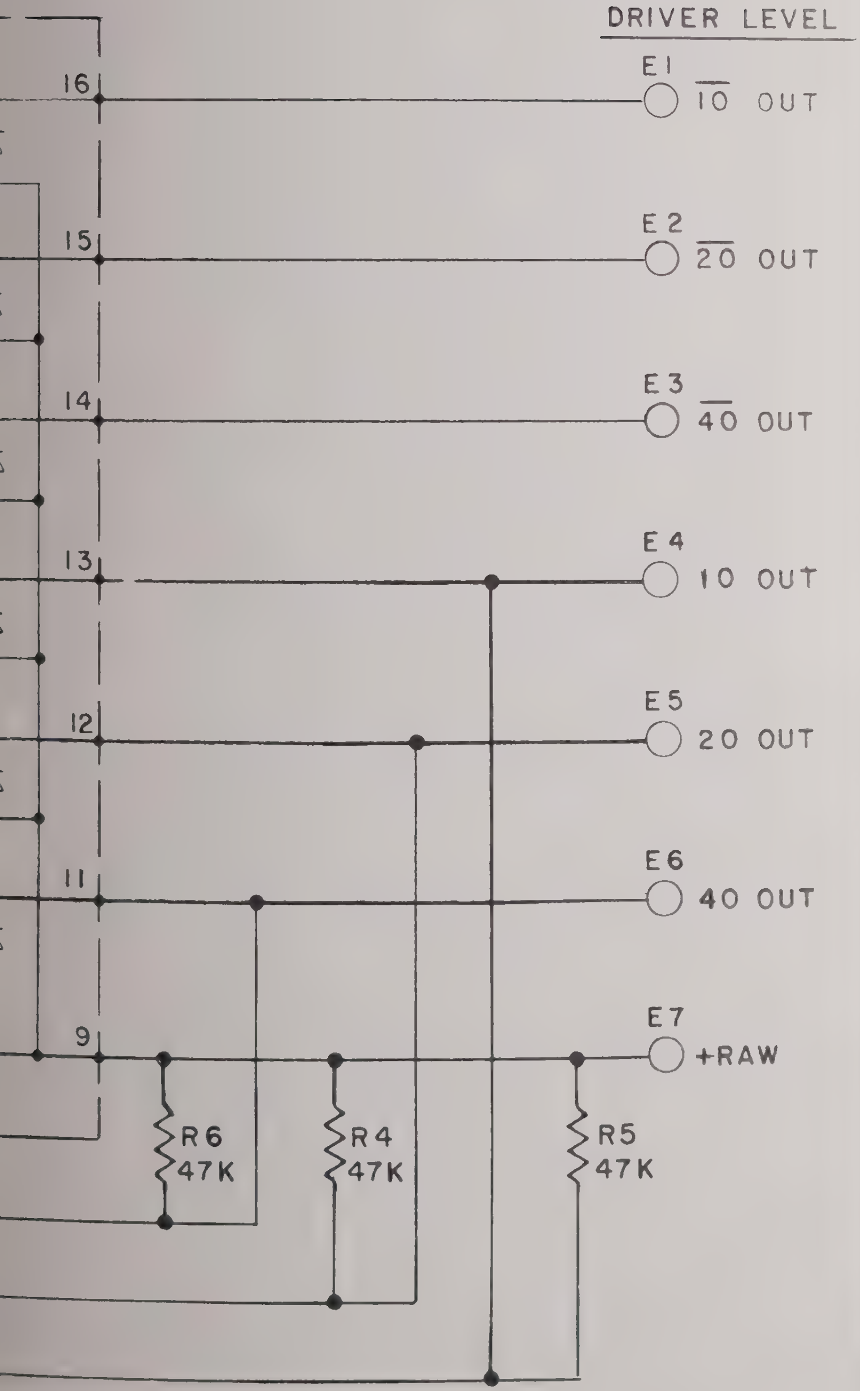

Z
Z
J1
NORM=L
OL=1Hz
3
15
7
8
VEE
+ SIGN=H
2
13
NORM=H
OL=1Hz
4
11
100'S DIGIT=H
1
9
U15
CD4054A
DISPLAY
DRIVER
2
STROBE
1
14
12
+12 V
11
R1
470
1
13
2
7
10'S DIGIT
CODE
4
9
8
12
GND
5,8
J1



NOTE:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%.

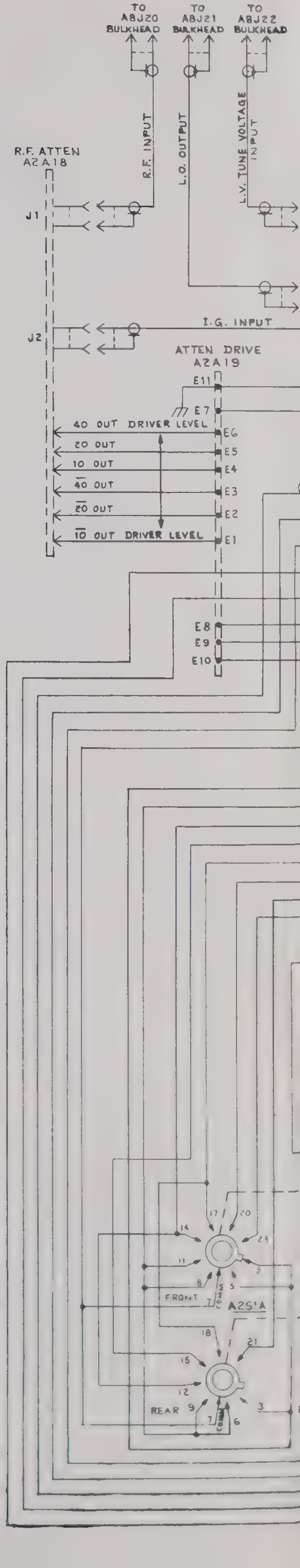
Figure 6.28
Attenuator Display BD
(A1A4)

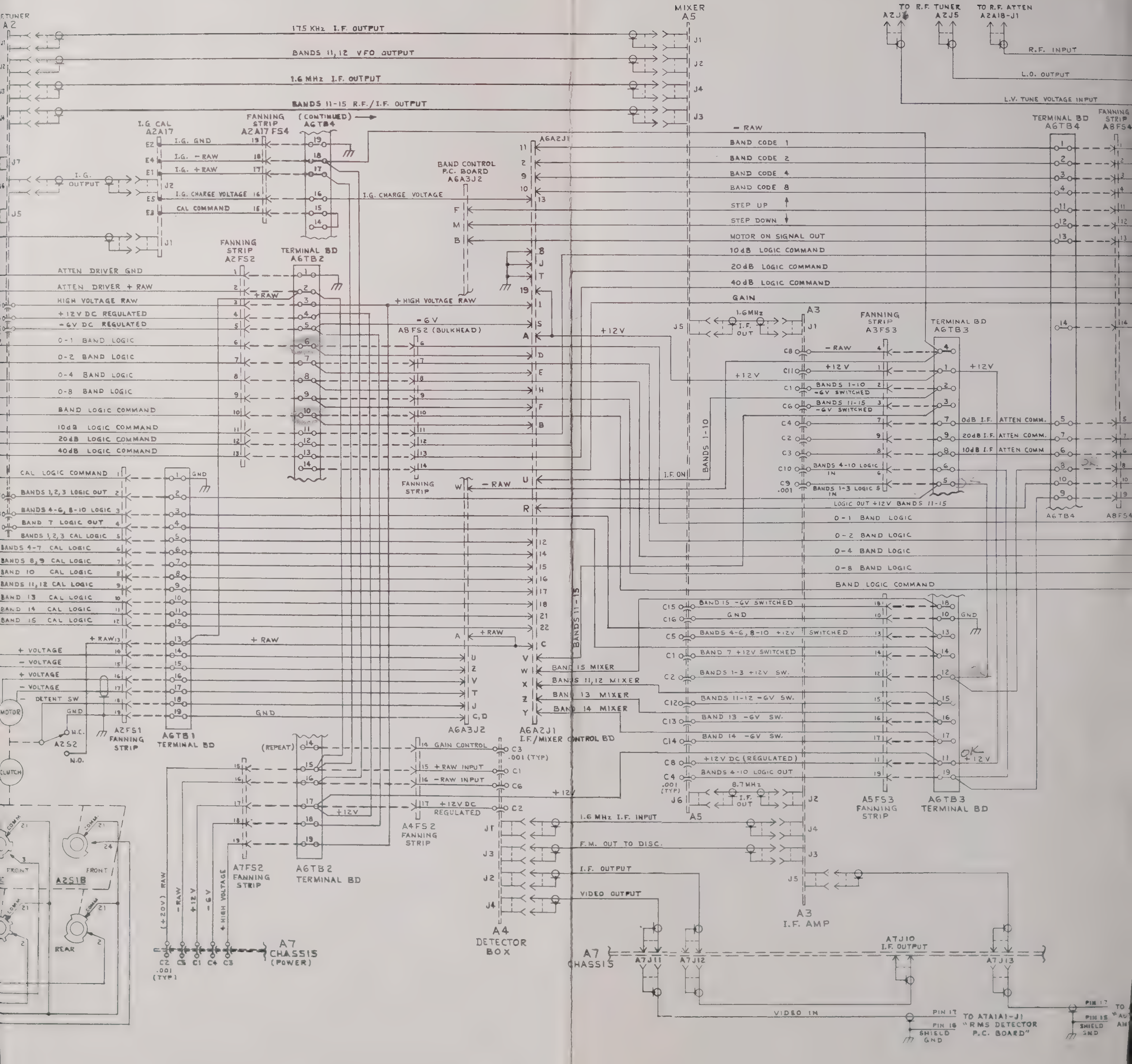

R1
47K
R2
47K
R3
47K
LOGIC LEVEL
E8
10 IN
E9
20 IN
E10
40 IN
E11
GND
1
2
3
4
5
6
8
U1
ULN-2001



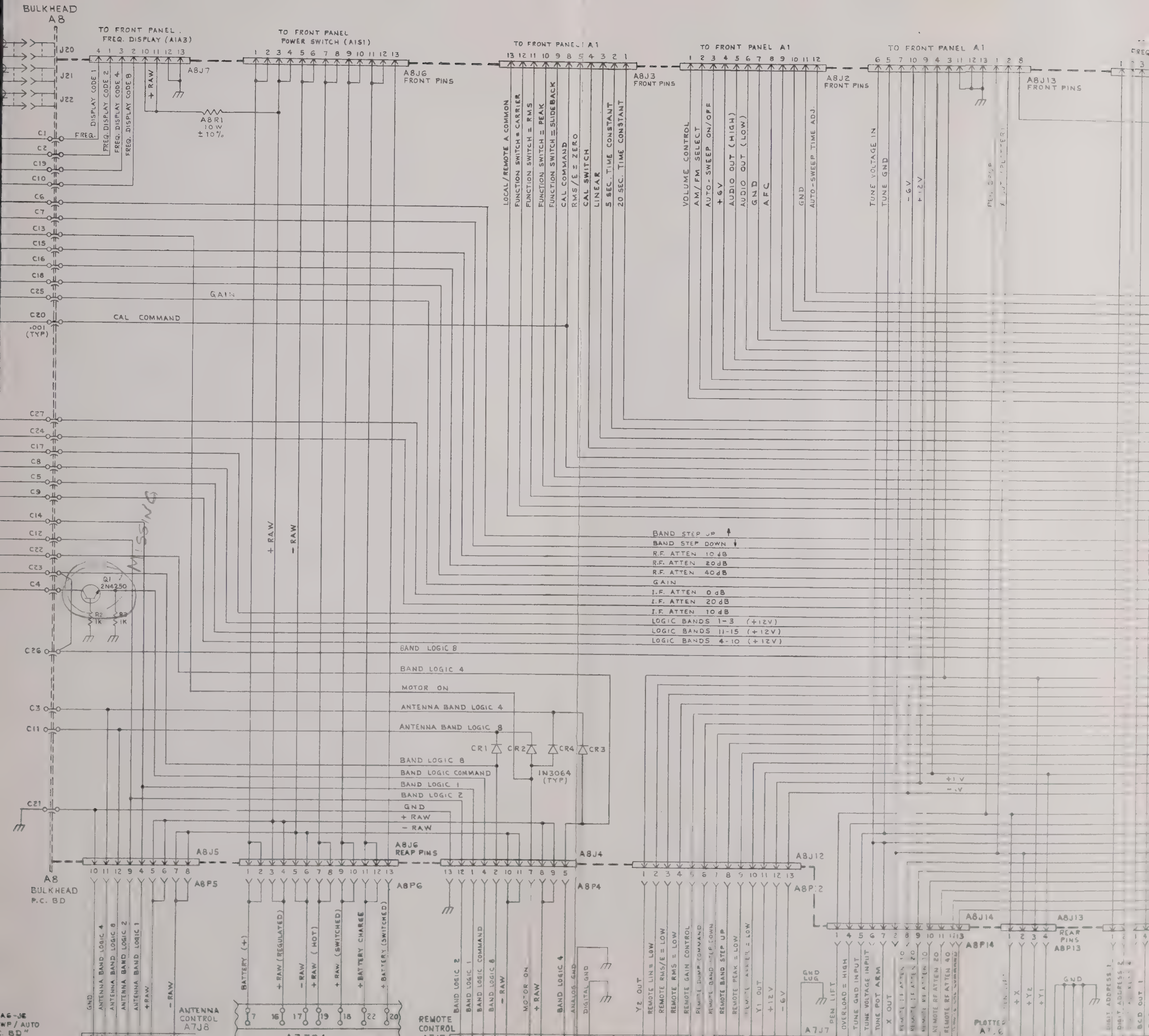
NOTE:
UNLESS OTHERWISE SPECIFIED
ALL RESISTOR VALUES ARE IN
OHMS ± 10%, 1/4 W

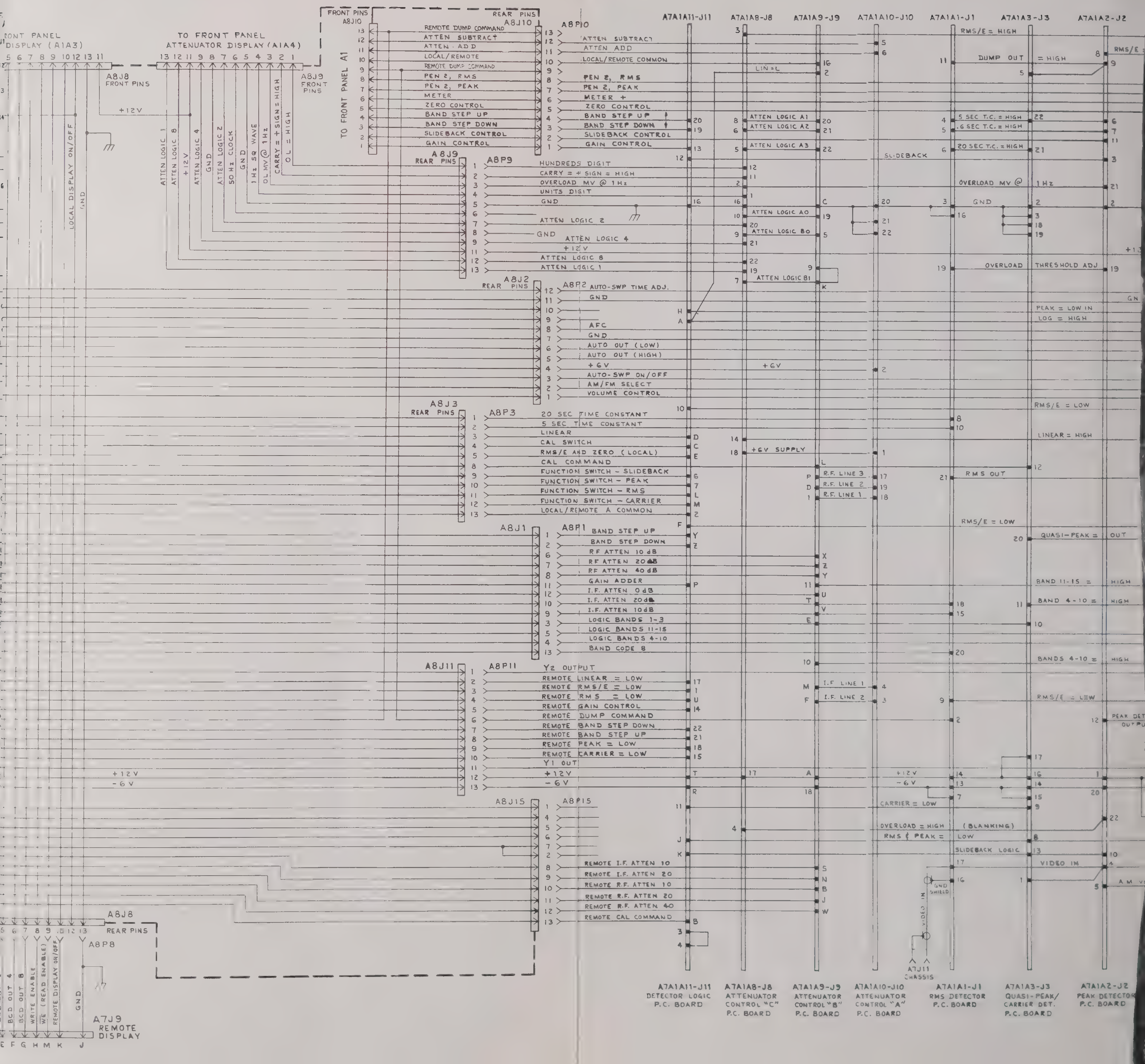
Figure 6.29
Attenuator Drive BD
(A2A19)


TO A8J20 BULKHEAD
TO A8J21 BULKHEAD
TO A8J22 BULKHEAD
R.F. INPUT
L.O. OUTPUT
L.V. TUNE VOLTAGE INPUT
R.F. ATTEN A2A18
J1
J2
I.G. INPUT
ATTEN DRIVE A2A19
E11
E7
40 OUT DRIVER LEVEL
E6
20 OUT
E5
10 OUT
E4
$\overline{40}$ OUT
E3
$\overline{20}$ OUT
E2
$\overline{10}$ OUT DRIVER LEVEL
E1
E8
E9
E10
17
20
14
23
11
8
5
FRONT
7
COM
A2S1A
18
21
15
12
REAR
9
7
COM
6
3

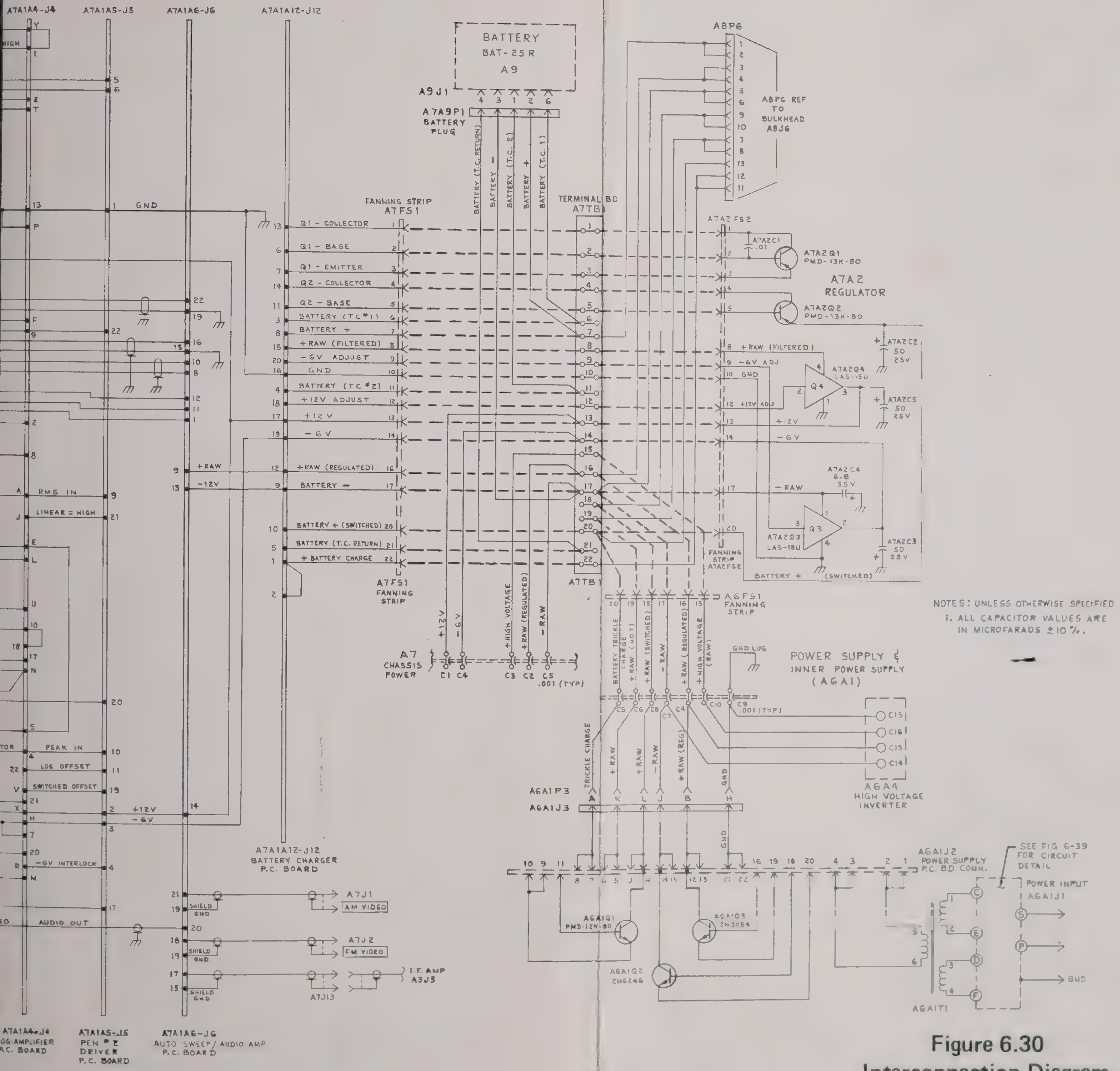


F. TUNER
A2
J1
J2
J3
J4
J7
J6
J5
17.5 KHz I.F. OUTPUT
BANDS 11, 12 VFO OUTPUT
1.6 MHz I.F. OUTPUT
BANDS 11-15 R.F./I.F. OUTPUT
MIXER
A5
J1
J2
J4
J3
TO R.F. TUNER
A2J6
A2J5
TO R.F. ATTEN
A2A18-J1
R.F. INPUT
L.O. OUTPUT
L.V. TUNE VOLTAGE INPUT
FANNING STRIP
A2A17 FS4
A6TB4
(CONTINUED)
I.G. CAL
A2A17
E2
E4
E1
E5
E3
I.G. GND
I.G. -RAW
I.G. +RAW
I.G. CHARGE VOLTAGE
CAL COMMAND
I.G. OUTPUT
J2
J1
I.G. CHARGE VOLTAGE
BAND CONTROL P.C. BOARD
A6A3J2
F
M
B
A6A2J1
- RAW
BAND CODE 1
BAND CODE 2
BAND CODE 4
BAND CODE 8
STEP UP
STEP DOWN
MOTOR ON SIGNAL OUT
10dB LOGIC COMMAND
20dB LOGIC COMMAND
40dB LOGIC COMMAND
GAIN
TERMINAL BD
A6TB4
FANNING STRIP
A8FS4
FANNING STRIP
A2FS2
TERMINAL BD
A6TB2
ATTEN DRIVER GND
ATTEN DRIVER + RAW
HIGH VOLTAGE RAW
+12V DC REGULATED
-6V DC REGULATED
0-1 BAND LOGIC
0-2 BAND LOGIC
0-4 BAND LOGIC
0-8 BAND LOGIC
BAND LOGIC COMMAND
10dB LOGIC COMMAND
20dB LOGIC COMMAND
40dB LOGIC COMMAND
+RAW
+ HIGH VOLTAGE RAW
-6V
A8FS2 (BULKHEAD)
FANNING STRIP
+12V
1.6MHz I.F. OUT
A3
J5
J1
FANNING STRIP
A3FS3
TERMINAL BD
A6TB3
- RAW
+12V
BANDS 1-10 -6V SWITCHED
BANDS 11-15 -6V SWITCHED
0dB I.F. ATTEN COMM.
20dB I.F. ATTEN COMM.
10dB I.F. ATTEN COMM
BANDS 4-10 LOGIC IN
BANDS 1-3 LOGIC IN
LOGIC OUT +12V BANDS 11-15
C8
C11
C1
C6
C4
C2
C3
C10
C9 .001
I.F. ON
BANDS 1-10
A6TB4
A8FS4
CAL LOGIC COMMAND
GND
BANDS 1, 2, 3 LOGIC OUT
BANDS 4-6, 8-10 LOGIC
BAND 7 LOGIC OUT
BANDS 1, 2, 3 CAL LOGIC
BANDS 4-7 CAL LOGIC
BANDS 8, 9 CAL LOGIC
BAND 10 CAL LOGIC
BANDS 11, 12 CAL LOGIC
BAND 13 CAL LOGIC
BAND 14 CAL LOGIC
BAND 15 CAL LOGIC
+ RAW
+ VOLTAGE
- VOLTAGE
+ VOLTAGE
- VOLTAGE
DETENT SW
GND
MOTOR
N.C.
A2S2
N.O.
CLUTCH
A2FS1 FANNING STRIP
A6TB1 TERMINAL BD
W
- RAW
U
R
0-1 BAND LOGIC
0-2 BAND LOGIC
0-4 BAND LOGIC
0-8 BAND LOGIC
BAND LOGIC COMMAND
BANDS 11-15
A
+ RAW
A6A3J2
A6A2J1
I.F./MIXER CONTROL BD
BAND 15 MIXER
BANDS 11, 12 MIXER
BAND 13 MIXER
BAND 14 MIXER
C15
C16
C5
C1
C2
C12
C13
C14
C8
C4 .001 (TYP)
BAND 15 -6V SWITCHED
GND
BANDS 4-6, 8-10 +12V SWITCHED
BAND 7 +12V SWITCHED
BANDS 1-3 +12V SW.
BANDS 11-12 -6V SW.
BAND 13 -6V SW.
BAND 14 -6V SW.
+12V DC (REGULATED)
BANDS 4-10 LOGIC OUT
GND
OK +12V
8.7MHz I.F. OUT
J6
J2
A5
A5FS3 FANNING STRIP
A6TB3 TERMINAL BD
(REPEAT)
14 GAIN CONTROL
15 + RAW INPUT
16 - RAW INPUT
17 +12V DC REGULATED
+12V
C3 .001 (TYP)
C1
C6
C2
A4FS2 FANNING STRIP
A7FS2 FANNING STRIP
A6TB2 TERMINAL BD
+12V
1.6 MHz I.F. INPUT
F.M. OUT TO DISC.
I.F. OUTPUT
VIDEO OUTPUT
J1
J3
J2
J4
J4
J3
J5
A4 DETECTOR BOX
A3 I.F. AMP
(+20V) RAW
-RAW
+12V
-6V
+ HIGH VOLTAGE
C2 .001 (TYP)
C5
C1
C4
C3
A7 CHASSIS (POWER)
A7 CHASSIS
A7J11
A7J12
A7J10 I.F. OUTPUT
A7J13
VIDEO IN
PIN 17
PIN 16
SHIELD GND
TO A7A1A1-J1 "RMS DETECTOR P.C. BOARD"
PIN 17
PIN 15
SHIELD GND
COMM
FRONT
A2S1B
REAR
21
24
3
2


BULKHEAD
A8
TO FRONT PANEL.
FREQ. DISPLAY (A1A3)
J20
J21
J22
A8J7
+ RAW
DISPLAY CODE 1
FREQ. DISPLAY CODE 2
FREQ. DISPLAY CODE 4
FREQ. DISPLAY CODE 8
FREQ.
A8R1
10W
±10%
TO FRONT PANEL
POWER SWITCH (A1S1)
A8J6
FRONT PINS
TO FRONT PANEL A1
LOCAL/REMOTE A COMMON
FUNCTION SWITCH = CARRIER
FUNCTION SWITCH = RMS
FUNCTION SWITCH = PEAK
FUNCTION SWITCH = SLIDEBACK
CAL COMMAND
RMS/E = ZERO
CAL SWITCH
LINEAR
5 SEC. TIME CONSTANT
20 SEC. TIME CONSTANT
A8J3
FRONT PINS
TO FRONT PANEL A1
VOLUME CONTROL
AM/FM SELECT
AUTO-SWEEP ON/OFF
+6V
AUDIO OUT (HIGH)
AUDIO OUT (LOW)
GND
AFC
GND
AUTO-SWEEP TIME ADJ.
A8J2
FRONT PINS
TO FRONT PANEL A1
TUNE VOLTAGE IN
TUNE GND
-6V
+12V
A8J13
FRONT PINS
C1
C2
C19
C10
C6
C7
C13
C15
C16
C18
C25
GAIN
C20
CAL COMMAND
.001
(TYP)
C27
C24
C17
C8
C5
C9
C14
C12
C22
C23
C4
Q1
2N4250
R2
1K
R3
1K
MISSING
+ RAW
- RAW
C26
C3
C11
C21
BAND STEP UP ↑
BAND STEP DOWN ↓
R.F. ATTEN 10 dB
R.F. ATTEN 20 dB
R.F. ATTEN 40 dB
GAIN
I.F. ATTEN 0 dB
I.F. ATTEN 20 dB
I.F. ATTEN 10 dB
LOGIC BANDS 1-3 (+12V)
LOGIC BANDS 11-15 (+12V)
LOGIC BANDS 4-10 (+12V)
BAND LOGIC 8
BAND LOGIC 4
MOTOR ON
ANTENNA BAND LOGIC 4
ANTENNA BAND LOGIC 8
CR1
CR2
CR4
CR3
1N3064
(TYP)
BAND LOGIC 8
BAND LOGIC COMMAND
BAND LOGIC 1
BAND LOGIC 2
GND
+ RAW
- RAW
+1V
-.V
A8J5
A8P5
A8
BULKHEAD
P.C. BD
A8J6
REAR PINS
A8P6
A8J4
A8P4
A8J12
A8P12
A8J14
A8P14
A8J13
REAR
PINS
A8P13
GND
ANTENNA BAND LOGIC 4
ANTENNA BAND LOGIC 8
ANTENNA BAND LOGIC 2
ANTENNA BAND LOGIC 1
+RAW
- RAW
ANTENNA
CONTROL
A7J8
A D E C B I H
BATTERY (+)
+ RAW (REGULATED)
- RAW
+ RAW (HOT)
+ RAW (SWITCHED)
+ BATTERY CHARGE
+ BATTERY (SWITCHED)
7 16 17 19 18 22 20
A7TB1
PARTIAL TERMINAL BD
REMOTE
CONTROL
A7J7
BAND LOGIC 2
BAND LOGIC 1
BAND LOGIC COMMAND
BAND LOGIC 8
- RAW
MOTOR ON
+ RAW
BAND LOGIC 4
ANALOG GND
DIGITAL GND
n k h t CC F HH r K z
Y2 OUT
REMOTE LIN = LOW
REMOTE RMS/E = LOW
REMOTE RMS = LOW
REMOTE GAIN CONTROL
REMOTE DUMP COMMAND
REMOTE BAND STEP DOWN
REMOTE BAND STEP UP
REMOTE PEAK = LOW
REMOTE CARRIER = LOW
Y1 OUT
+12V
-6V
d L H m P T Y e f P b V X AA
GND
LUG
A7J7
PEN LIFT
OVERLOAD = HIGH
TUNE GND INPUT
TUNE VOLTAGE INPUT
TUNE POT ARM
X OUT
REMOTE IF ATTEN 10
REMOTE IF ATTEN 20
REMOTE RF ATTEN 10
REMOTE RF ATTEN 20
REMOTE RF ATTEN 40
M E J C A C s g u v w &
PLOTTER
+ X
+ Y2
+ Y1
D R H M A C E F
DIGIT ADDRESS 1
DIGIT ADDRESS 2
BCD OUT 1
A6-J6
WP/AUTO
C. BD"



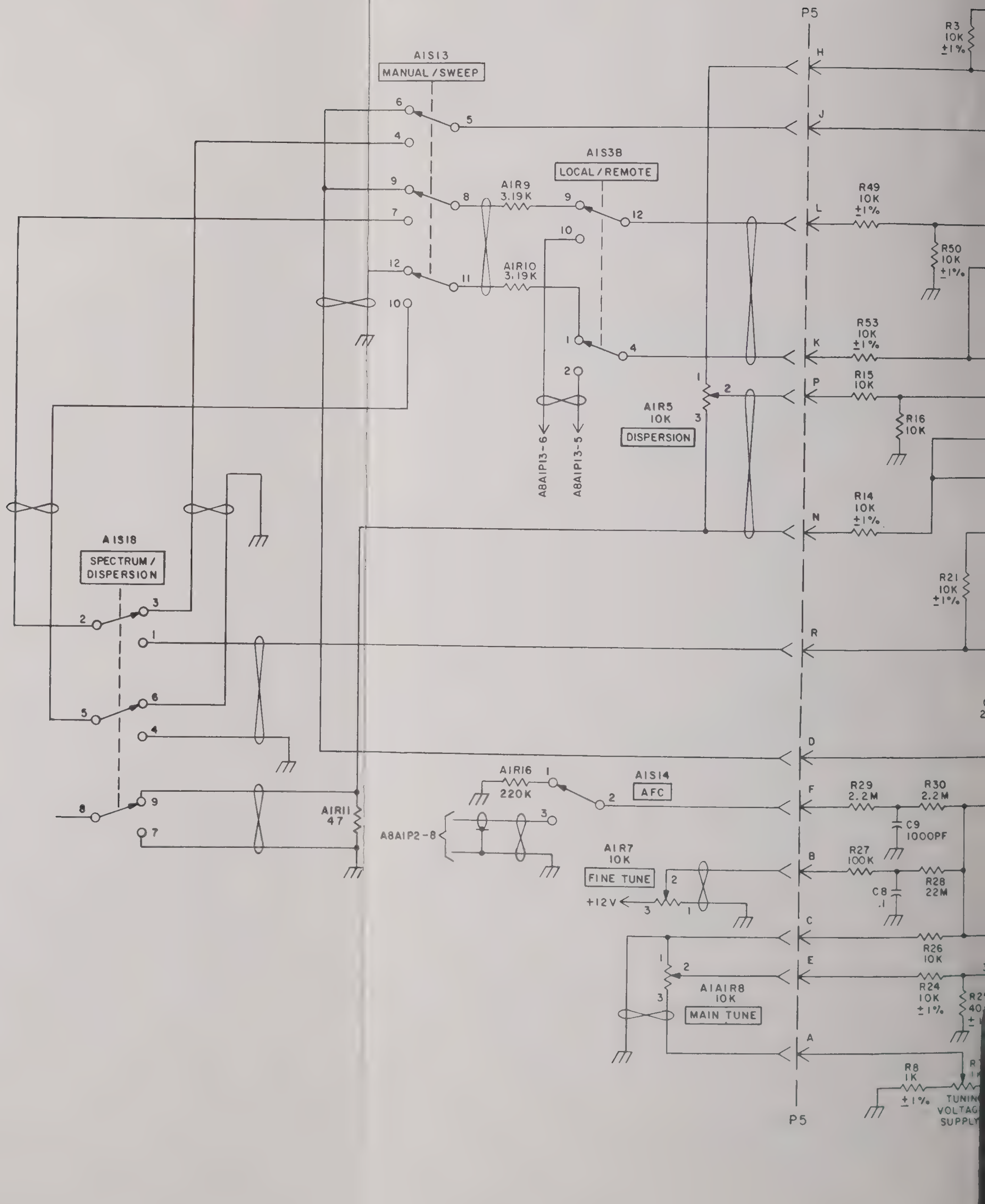
FRONT PANEL DISPLAY (A1A3)
TO FRONT PANEL ATTENUATOR DISPLAY (A1A4)
A8J8 FRONT PINS
A8J9 FRONT PINS
FRONT PINS A8J10
REAR PINS A8J10
TO FRONT PANEL A1
A8P10
+12V
LOCAL DISPLAY ON/OFF
GND
ATTEN LOGIC 1
ATTEN LOGIC 8
+12V
ATTEN LOGIC 4
GND
ATTEN LOGIC 2
50 Hz CLOCK
GND
1 Hz SQ WAVE
OL MV @ 1 Hz
CARRY = + SIGN = HIGH
OL = HIGH
REMOTE DUMP COMMAND
ATTEN SUBTRACT
ATTEN ADD
LOCAL/REMOTE
REMOTE DUMP COMMAND
PEN 2, RMS
PEN 2, PEAK
METER
ZERO CONTROL
BAND STEP UP
BAND STEP DOWN
SLIDEBACK CONTROL
GAIN CONTROL
ATTEN SUBTRACT
ATTEN ADD
LOCAL/REMOTE COMMON
PEN 2, RMS
PEN 2, PEAK
METER +
ZERO CONTROL
BAND STEP UP
BAND STEP DOWN
SLIDEBACK CONTROL
GAIN CONTROL
A8J9 REAR PINS
A8P9
HUNDREDS DIGIT
CARRY = + SIGN = HIGH
OVERLOAD MV @ 1 Hz
UNITS DIGIT
GND
ATTEN LOGIC 2
GND
ATTEN LOGIC 4
+12V
ATTEN LOGIC 8
ATTEN LOGIC 1
A8J2 REAR PINS
A8P2
AUTO-SWP TIME ADJ.
GND
AFC
GND
AUTO OUT (LOW)
AUTO OUT (HIGH)
+6V
AUTO-SWP ON/OFF
AM/FM SELECT
VOLUME CONTROL
A8J3 REAR PINS
A8P3
20 SEC TIME CONSTANT
5 SEC TIME CONSTANT
LINEAR
CAL SWITCH
RMS/E AND ZERO (LOCAL)
CAL COMMAND
FUNCTION SWITCH ~ SLIDEBACK
FUNCTION SWITCH – PEAK
FUNCTION SWITCH – RMS
FUNCTION SWITCH – CARRIER
LOCAL/REMOTE A COMMON
A8J1
A8P1
BAND STEP UP
BAND STEP DOWN
RF ATTEN 10 dB
RF ATTEN 20 dB
RF ATTEN 40 dB
GAIN ADDER
I.F. ATTEN 0 dB
I.F. ATTEN 20 dB
I.F. ATTEN 10 dB
LOGIC BANDS 1-3
LOGIC BANDS 11-15
LOGIC BANDS 4-10
BAND CODE 8
A8J11
A8P11
Y2 OUTPUT
REMOTE LINEAR = LOW
REMOTE RMS/E = LOW
REMOTE RMS = LOW
REMOTE GAIN CONTROL
REMOTE DUMP COMMAND
REMOTE BAND STEP DOWN
REMOTE BAND STEP UP
REMOTE PEAK = LOW
REMOTE CARRIER = LOW
Y1 OUT
+12V
-6V
+12V
-6V
A8J15
A8P15
REMOTE I.F. ATTEN 10
REMOTE I.F. ATTEN 20
REMOTE R.F. ATTEN 10
REMOTE R.F. ATTEN 20
REMOTE R.F. ATTEN 40
REMOTE CAL COMMAND
A8J8 REAR PINS
A8P8
BCD OUT 4
BCD OUT 8
WRITE ENABLE
WE (READ ENABLE)
REMOTE DISPLAY ON/OFF
GND
A7J9 REMOTE DISPLAY
E F G H M K J
A7A1A11-J11
A7A1A8-J8
A7A1A9-J9
A7A1A10-J10
A7A1A1-J1
A7A1A3-J3
A7A1A2-J2
LIN = L
RMS/E = HIGH
DUMP OUT = HIGH
RMS/E
ATTEN LOGIC A1
ATTEN LOGIC A2
ATTEN LOGIC A3
5 SEC T.C. = HIGH
.6 SEC T.C. = HIGH
20 SEC T.C. = HIGH
SLIDEBACK
OVERLOAD MV @ 1 Hz
ATTEN LOGIC A0
ATTEN LOGIC B0
ATTEN LOGIC B1
GND
+13
OVERLOAD THRESHOLD ADJ
GN
PEAK = LOW IN
LOG = HIGH
+6V
RMS/E = LOW
LINEAR = HIGH
+6V SUPPLY
R.F. LINE 3
R.F. LINE 2
R.F. LINE 1
RMS OUT
RMS/E = LOW
QUASI-PEAK = OUT
BAND 11-15 = HIGH
BAND 4-10 = HIGH
BANDS 4-10 = HIGH
I.F. LINE 1
I.F. LINE 2
RMS/E = LOW
PEAK DET OUTPU
+12V
-6V
CARRIER = LOW
OVERLOAD = HIGH (BLANKING)
RMS & PEAK = LOW
SLIDEBACK LOGIC
VIDEO IN
GND SHIELD
VIDEO IN
A M V
A7J11 CHASSIS
A7A1A11-J11 DETECTOR LOGIC P.C. BOARD
A7A1A8-J8 ATTENUATOR CONTROL "C" P.C. BOARD
A7A1A9-J9 ATTENUATOR CONTROL "B" P.C. BOARD
A7A1A10-J10 ATTENUATOR CONTROL "A" P.C. BOARD
A7A1A1-J1 RMS DETECTOR P.C. BOARD
A7A1A3-J3 QUASI-PEAK/CARRIER DET. P.C. BOARD
A7A1A2-J2 PEAK DETECTOR P.C. BOARD



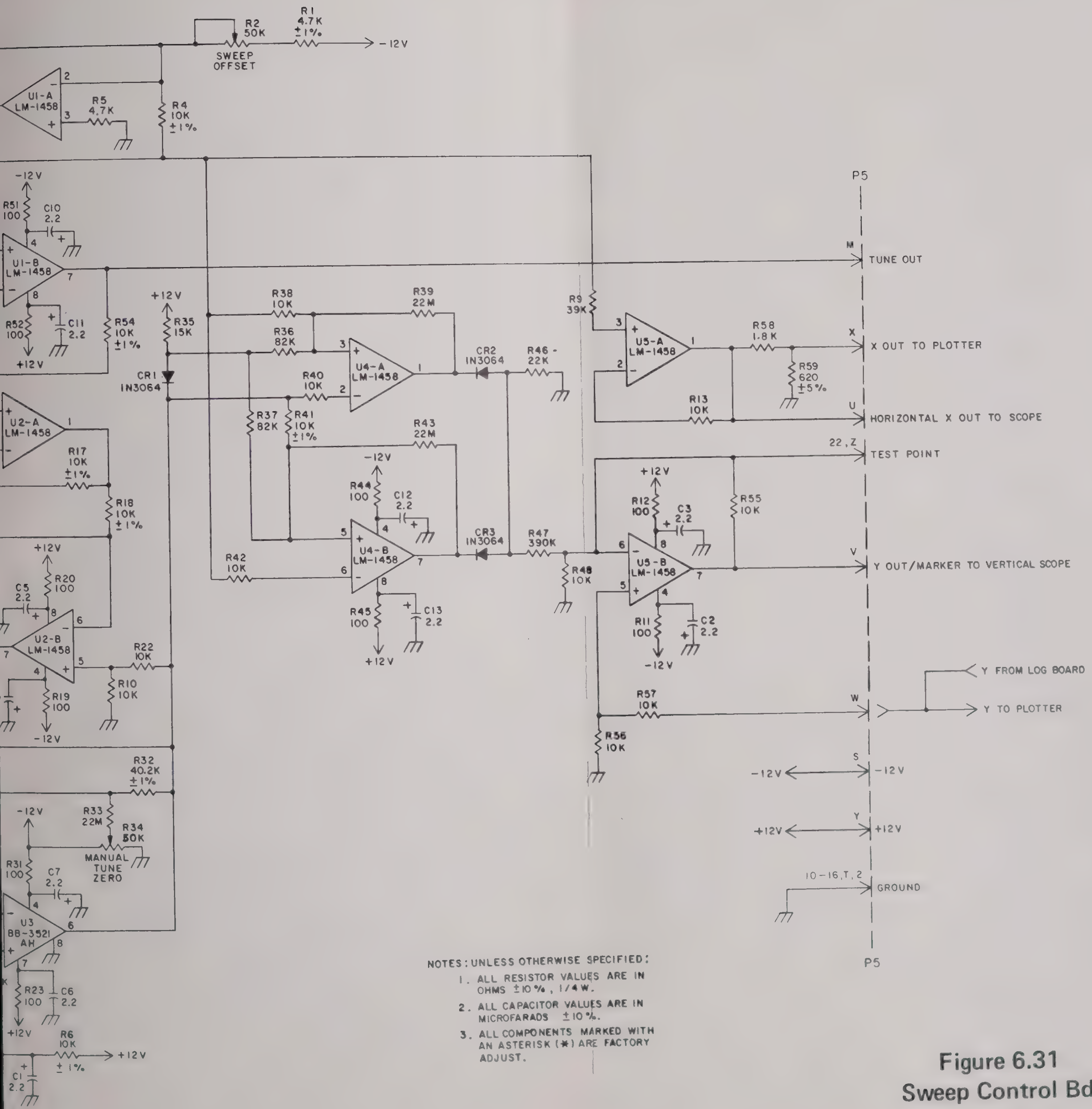
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.

Figure 6.30
Interconnection Diagram
Main Unit

R.F
6
4
5
01
(P)



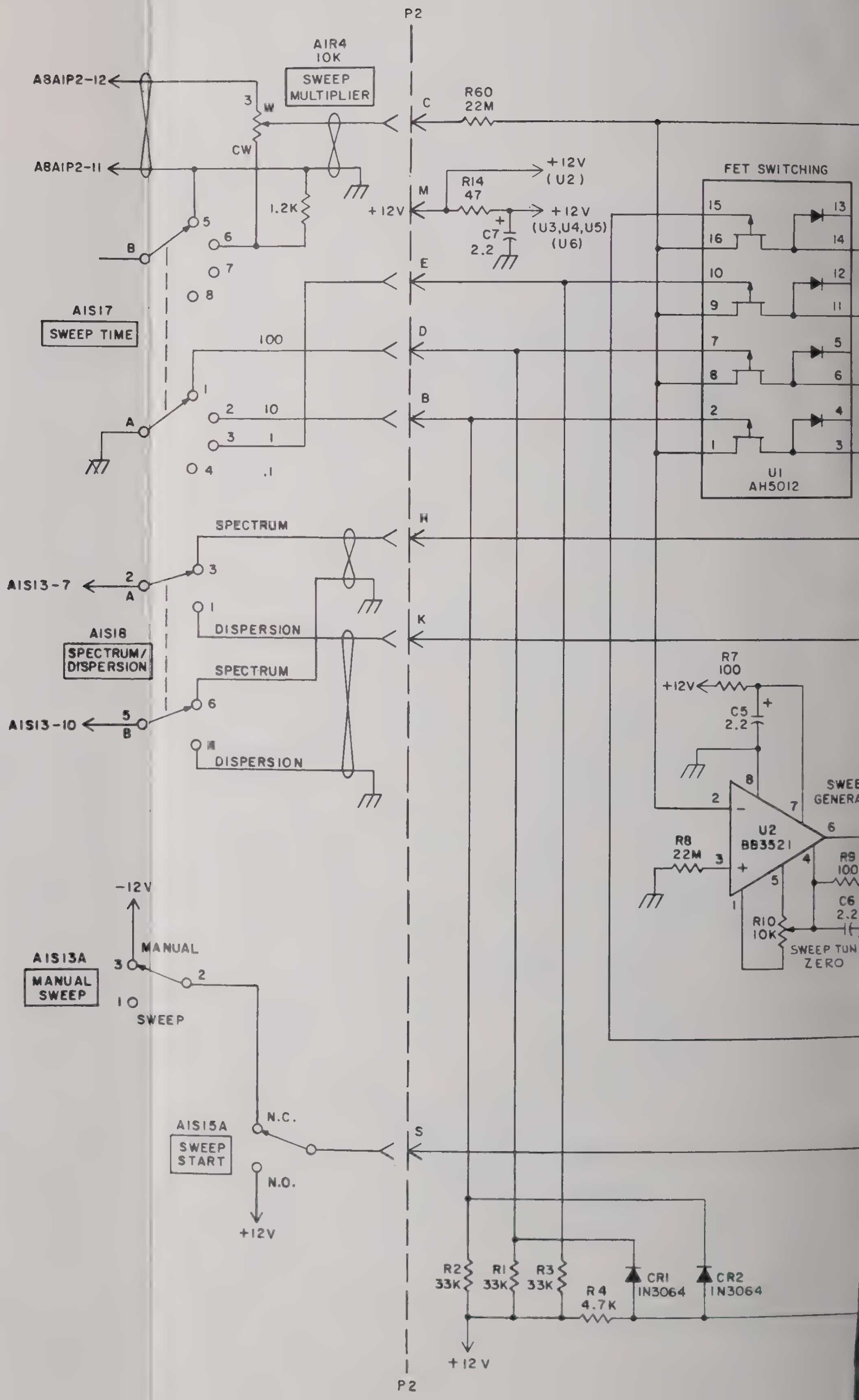
P5
R3
10K
±1%
H
A1S13
MANUAL / SWEEP
6
5
J
4
A1S38
LOCAL / REMOTE
9
8
A1R9
3.19K
9
12
R49
10K
±1%
L
7
10
R50
10K
±1%
12
11
A1R10
3.19K
10
1
4
R53
10K
±1%
K
2
A8A1P13-6
A8A1P13-5
A1R5
10K
DISPERSION
1
2
3
P
R15
10K
R16
10K
R14
10K
±1%
N
A1S18
SPECTRUM / DISPERSION
2
3
1
R21
10K
±1%
R
5
6
4
D
A1R16
220K
1
2
A1S14
AFC
F
R29
2.2M
R30
2.2M
C9
1000PF
8
9
7
A1R11
47
A8A1P2-8
3
A1R7
10K
FINE TUNE
2
+12V
3
1
B
R27
100K
C8
.1
R28
22M
C
R26
10K
1
2
3
A1A1R8
10K
MAIN TUNE
E
R24
10K
±1%
A
R8
1K
±1%
TUNING VOLTAGE SUPPLY
P5

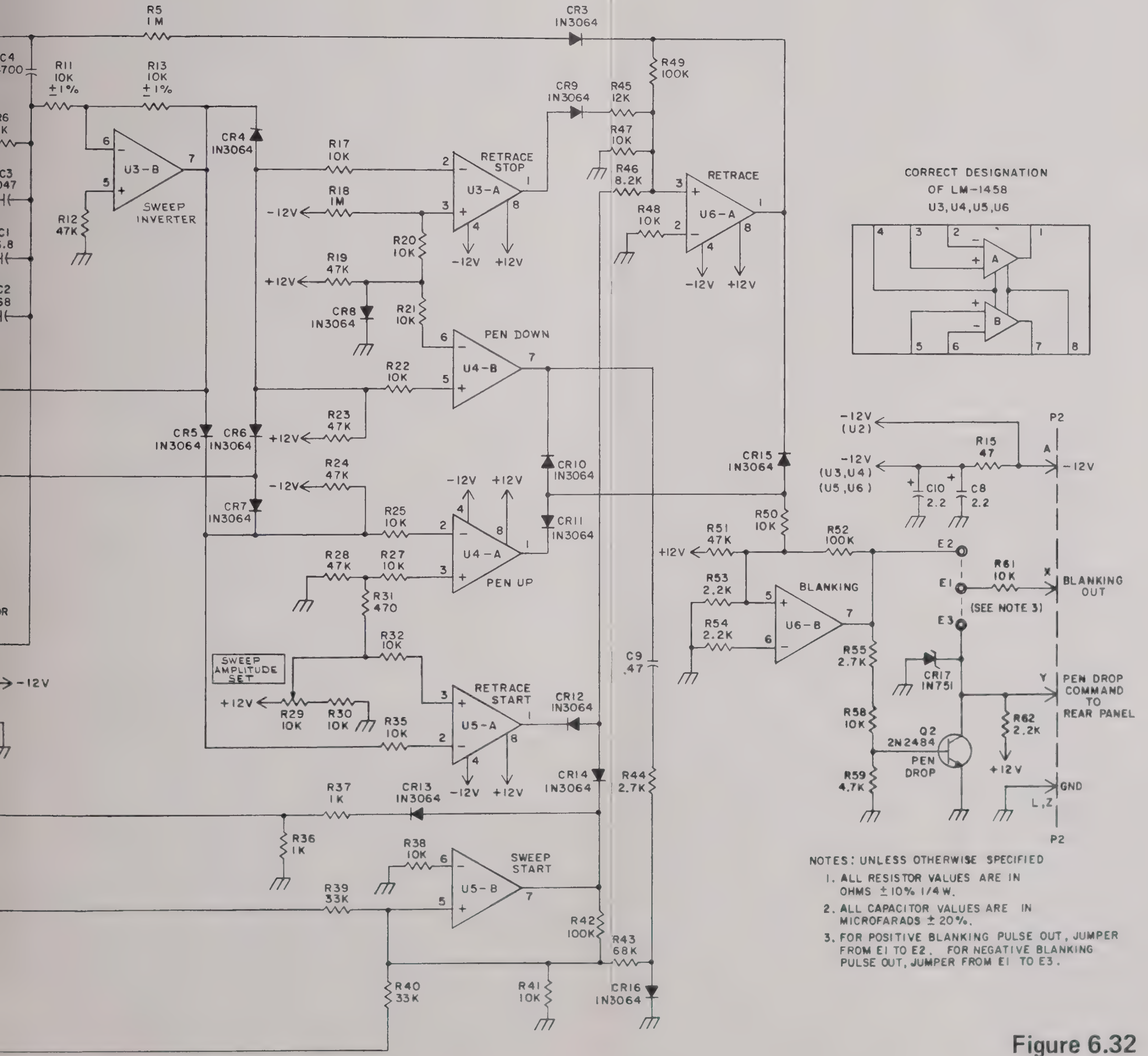


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.31
Sweep Control Bd
(A1A5)

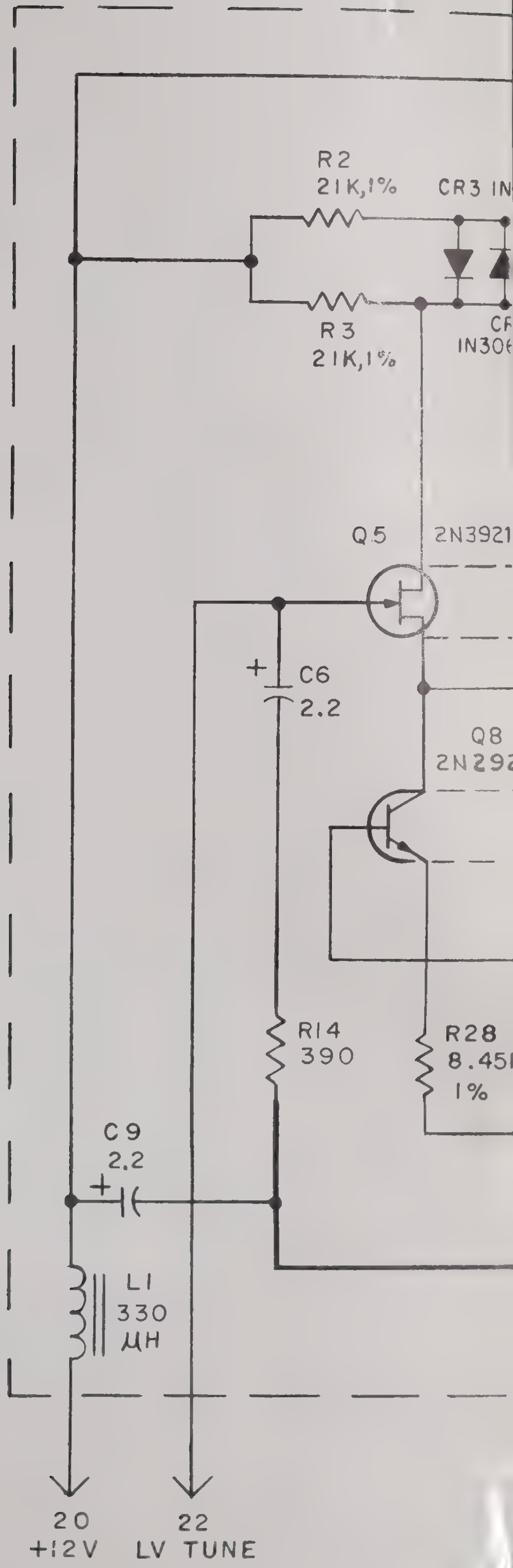

P2
A1R4
10K
SWEEP MULTIPLIER
A8A1P2-12
A8A1P2-11
3
W
CW
R60
22M
C
1.2K
M
R14
47
+12V
(U2)
+12V
+12V
(U3,U4,U5)
(U6)
C7
2.2
FET SWITCHING
15
16
13
14
10
9
12
11
7
8
5
6
2
1
4
3
U1
AH5012
B
5
6
7
8
E
A1S17
SWEEP TIME
100
D
A
1
2
10
3
1
B
4
.1
SPECTRUM
H
A1S13-7
2
A
3
1
A1S18
SPECTRUM/DISPERSION
DISPERSION
K
SPECTRUM
A1S13-10
5
B
6
DISPERSION
R7
100
+12V
C5
2.2
8
2
7
SWEE
GENERA
U2
BB3521
6
R8
22M
3
4
5
1
R9
100
C6
2.2
R10
10K
SWEEP TUN
ZERO
-12V
MANUAL
A1S13A
MANUAL SWEEP
3
2
1
SWEEP
A1S15A
SWEEP START
N.C.
N.O.
+12V
S
R2
33K
R1
33K
R3
33K
R4
4.7K
CR1
1N3064
CR2
1N3064
+12 V
P2

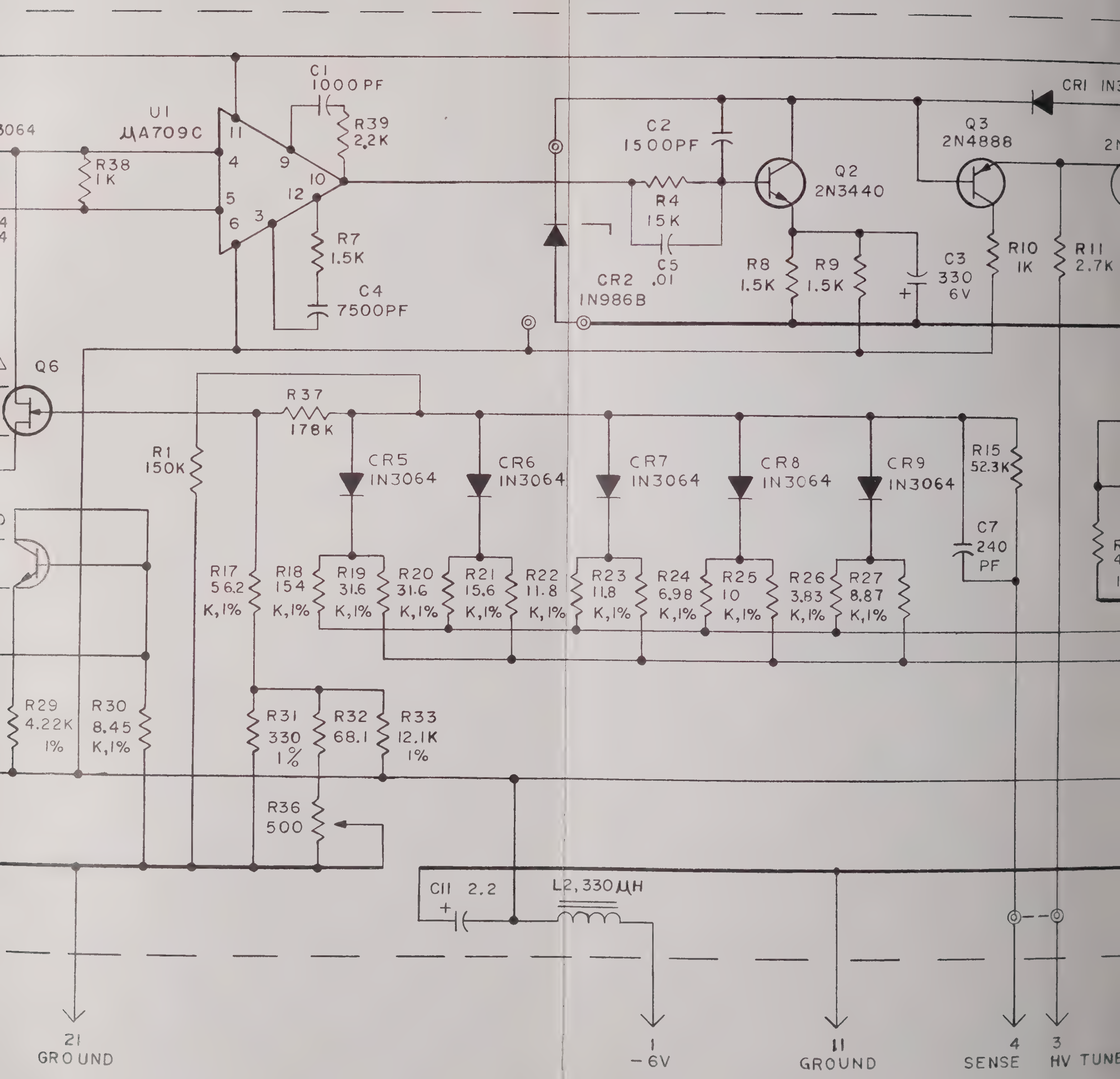


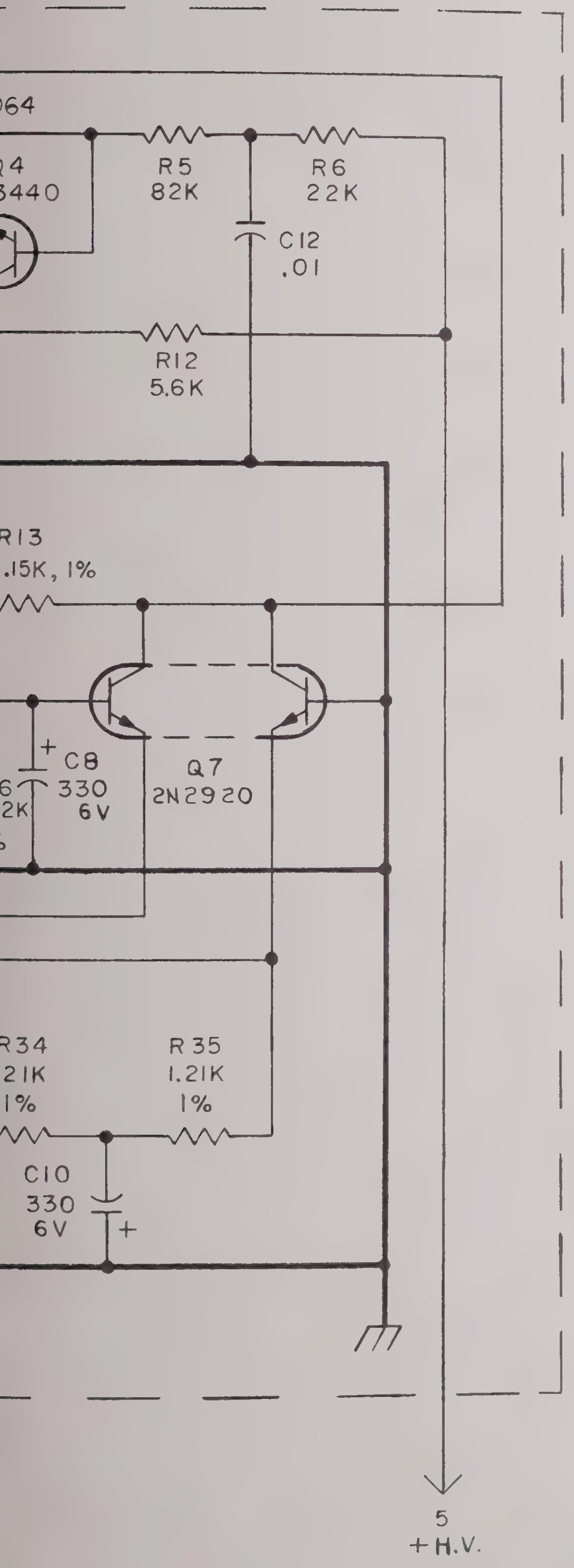
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS ± 10% 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%.
3. FOR POSITIVE BLANKING PULSE OUT, JUMPER FROM E1 TO E2. FOR NEGATIVE BLANKING PULSE OUT, JUMPER FROM E1 TO E3.

Figure 6.32
Sweep Bd
(A1A6)


R2
21K,1%
CR3 IN
R3
21K,1%
CR
IN306
Q5
2N3921
C6
2.2
Q8
2N292
R14
390
R28
8.45
1%
C9
2.2
L1
330
µH
20
+12V
22
LV TUNE

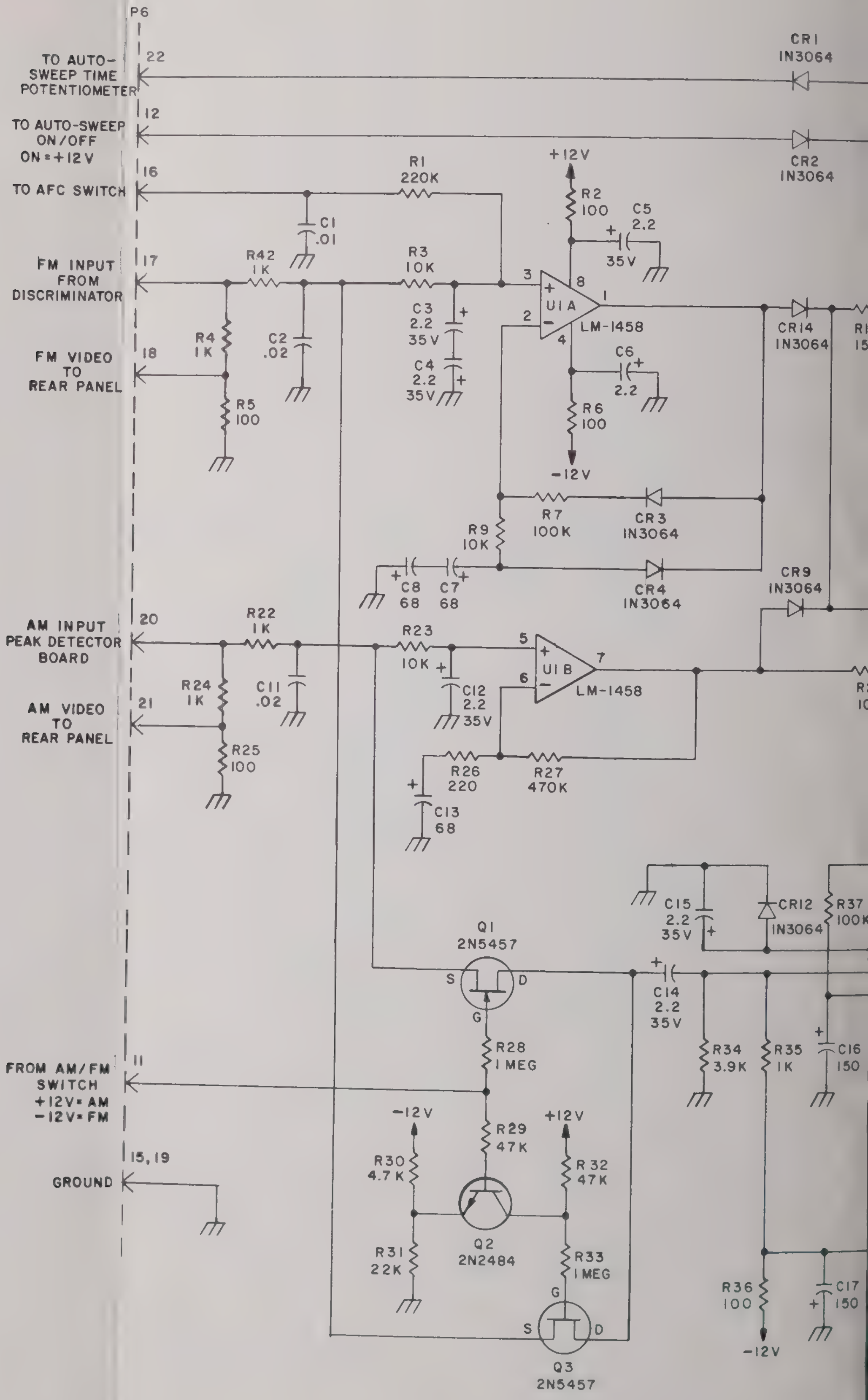

3064
U1
µA709C
C1
1000PF
R39
2.2K
R38
1K
C2
1500PF
Q2
2N3440
R4
15K
C5
.01
CR2
1N986B
R8
1.5K
R9
1.5K
C3
330
6V
CR1 IN3
Q3
2N4888
2N
R10
1K
R11
2.7K
R7
1.5K
C4
7500PF
Q6
R37
178K
R1
150K
CR5
1N3064
CR6
1N3064
CR7
1N3064
CR8
1N3064
CR9
1N3064
R15
52.3K
C7
240
PF
R17
56.2
K,1%
R18
154
K,1%
R19
31.6
K,1%
R20
31.6
K,1%
R21
15.6
K,1%
R22
11.8
K,1%
R23
11.8
K,1%
R24
6.98
K,1%
R25
10
K,1%
R26
3.83
K,1%
R27
8.87
K,1%
R29
4.22K
1%
R30
8.45
K,1%
R31
330
1%
R32
68.1
R33
12.1K
1%
R36
500
C11 2.2
L2, 330µH
21
GROUND
1
-6V
11
GROUND
4
SENSE
3
HV TUNE

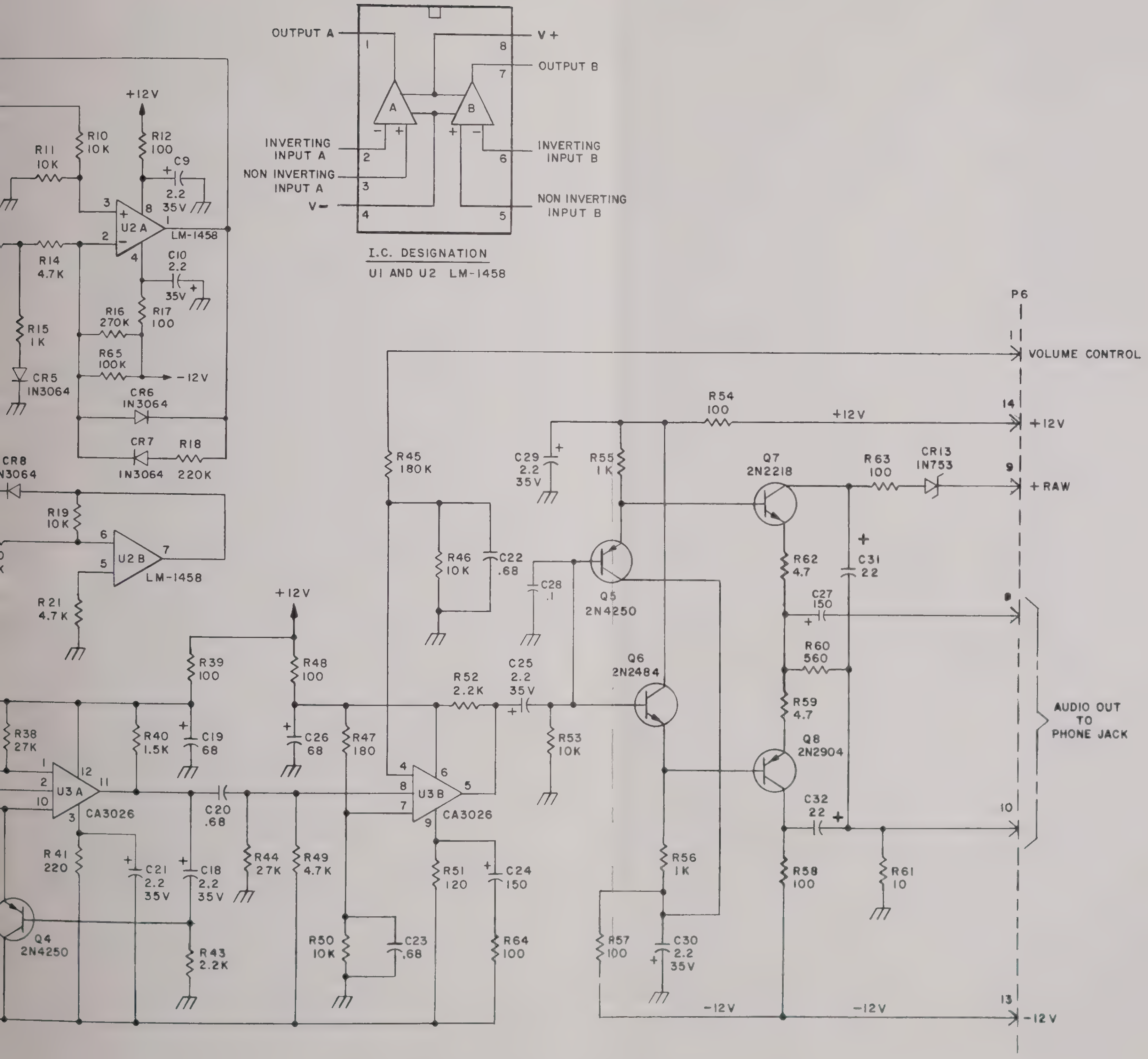


NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, ± 10%, 1/4 W.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED ✱ ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASS'Y. EXAMPLE R5 ON ASS'Y A5P4, COMPLETE PART NUMBER IS A5P4 (R5).
6. Q3 IS NOT INSTALLED ON ALL ASSEMBLIES.
7. CR2 (IN986B) IS SELECTIVELY CONNECTED AS SHOWN.
8. △ DENOTES FACTORY MATCHED PAIR (TEXAS INSTRUMENT).

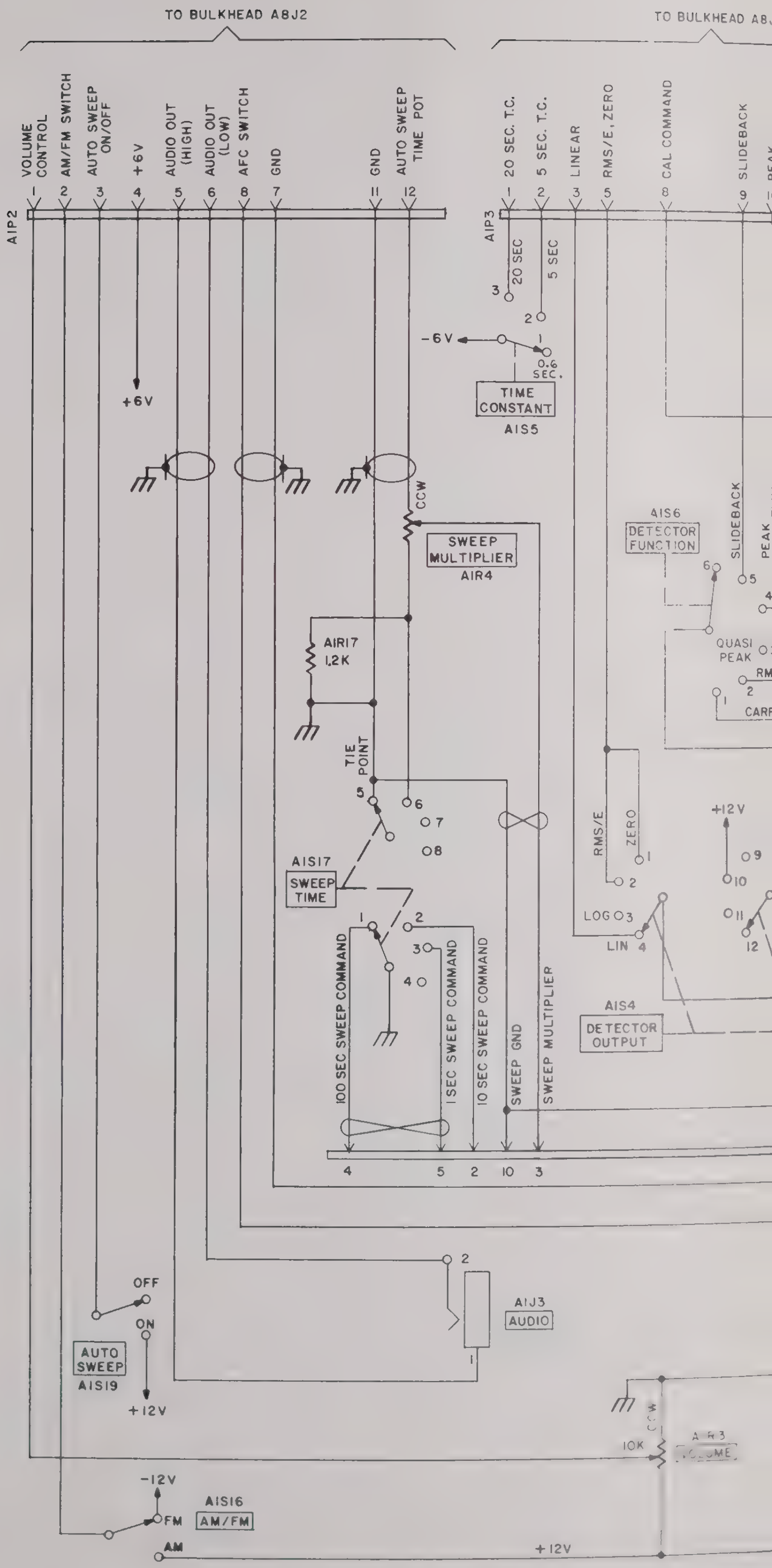
Figure 6.33
Tuning Regulator Bd
(A2A16A2)

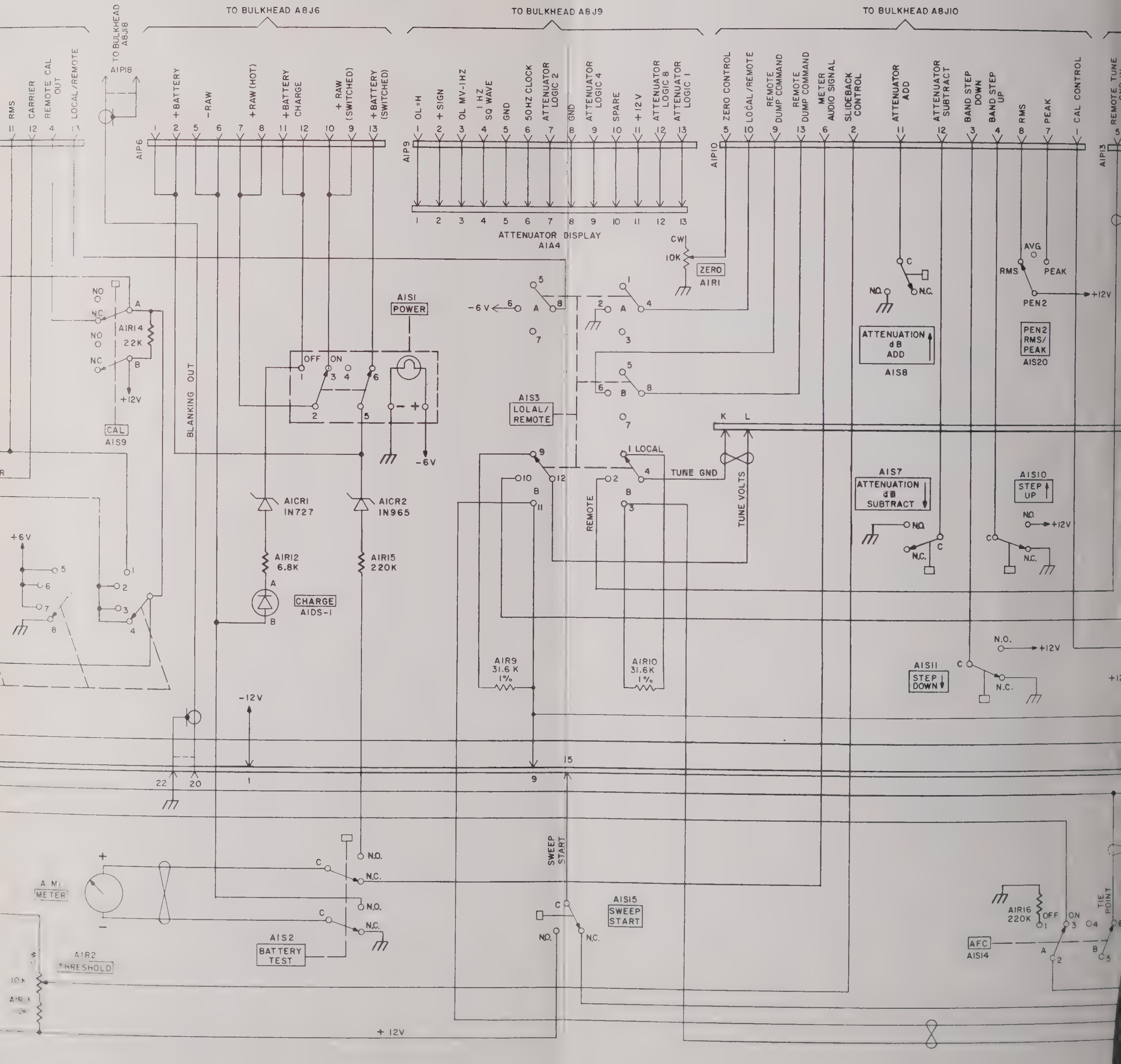

P6
TO AUTO-SWEEP TIME POTENTIOMETER
22
TO AUTO-SWEEP ON/OFF ON=+12V
12
TO AFC SWITCH
16
FM INPUT FROM DISCRIMINATOR
17
FM VIDEO TO REAR PANEL
18
AM INPUT PEAK DETECTOR BOARD
20
AM VIDEO TO REAR PANEL
21
FROM AM/FM SWITCH +12V=AM -12V=FM
11
GROUND
15, 19
CR1 1N3064
CR2 1N3064
R1 220K
C1 .01
+12V
R2 100
C5 2.2 35V
R42 1K
R3 10K
C3 2.2 35V
C4 2.2 35V
R4 1K
C2 .02
R5 100
3
2
8
1
4
U1A
LM-1458
C6 2.2
R6 100
-12V
CR14 1N3064
R7 100K
CR3 1N3064
R9 10K
C8 68
C7 68
CR4 1N3064
CR9 1N3064
R22 1K
R23 10K
R24 1K
C11 .02
C12 2.2 35V
R25 100
5
6
7
U1B
LM-1458
R26 220
R27 470K
C13 68
C15 2.2 35V
CR12 1N3064
R37 100K
Q1 2N5457
S
D
G
C14 2.2 35V
R34 3.9K
R35 1K
C16 150
R28 1 MEG
-12V
R29 47K
+12V
R30 4.7K
R32 47K
R31 22K
Q2 2N2484
R33 1 MEG
G
S
D
Q3 2N5457
R36 100
C17 150
-12V

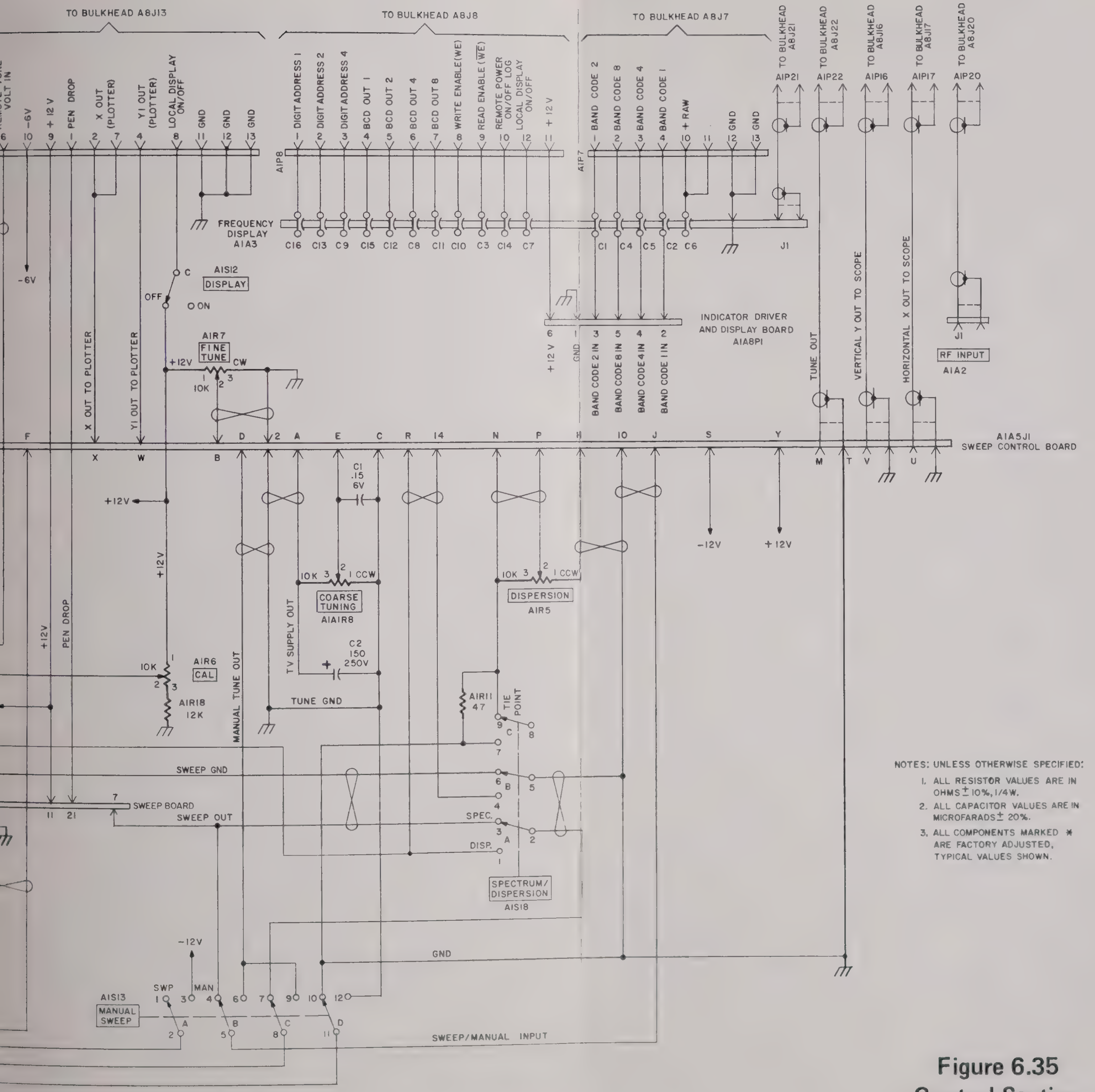


NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.34
Auto Sweep/Audio Amplifier Bd (A7A1A6)


TO BULKHEAD A8J2
TO BULKHEAD A8J
VOLUME CONTROL
AM/FM SWITCH
AUTO SWEEP ON/OFF
+6V
AUDIO OUT (HIGH)
AUDIO OUT (LOW)
AFC SWITCH
GND
GND
AUTO SWEEP TIME POT
1
2
3
4
5
6
8
7
11
12
A1P2
20 SEC. T.C.
5 SEC. T.C.
LINEAR
RMS/E, ZERO
CAL COMMAND
SLIDEBACK
1
2
3
5
8
9
A1P3
20 SEC
5 SEC
3
2
1
-6V
0.6 SEC.
TIME CONSTANT
A1S5
+6V
CCW
SWEEP MULTIPLIER
A1R4
A1S6
DETECTOR FUNCTION
SLIDEBACK
PEAK
6
5
4
QUASI PEAK
RM
2
1
CARR
A1R17
1,2K
TIE POINT
5
6
7
8
A1S17
SWEEP TIME
1
2
3
4
RMS/E
ZERO
1
2
+12V
9
10
11
12
LOG 3
LIN 4
A1S4
DETECTOR OUTPUT
100 SEC SWEEP COMMAND
1 SEC SWEEP COMMAND
10 SEC SWEEP COMMAND
SWEEP GND
SWEEP MULTIPLIER
4
5
2
10
3
2
A1J3
AUDIO
1
OFF
ON
AUTO SWEEP
A1S19
+12V
CCW
10K
A1R3
VOLUME
-12V
A1S16
FM
AM/FM
AM
+12V

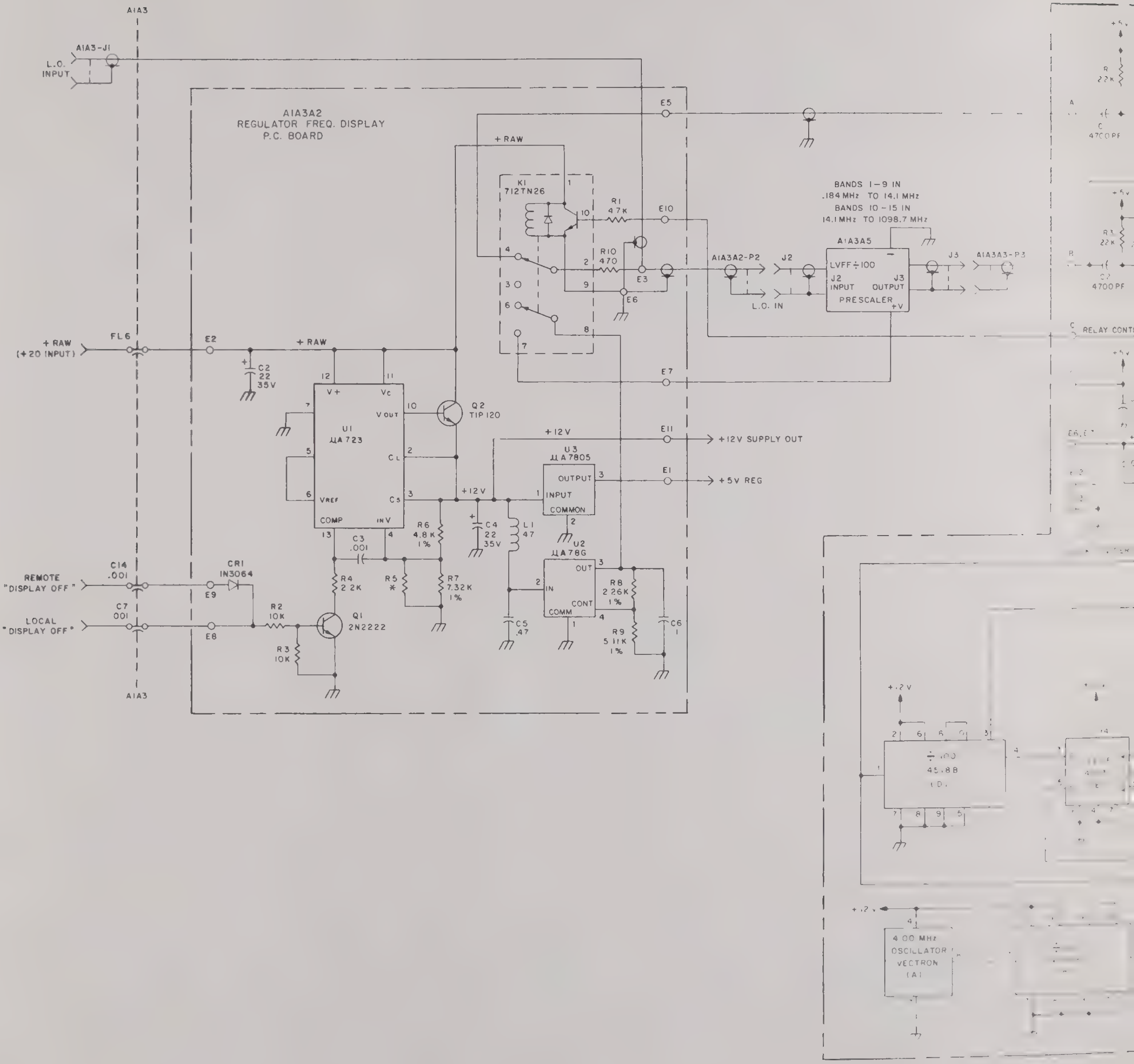

TO BULKHEAD A8J6
TO BULKHEAD A8J9
TO BULKHEAD A8J10
TO BULKHEAD A8J18
A1P18
RMS
CARRIER
REMOTE CAL OUT
LOCAL/REMOTE
A1P6
+BATTERY
-RAW
+RAW (HOT)
+BATTERY CHARGE
+RAW (SWITCHED)
+BATTERY (SWITCHED)
A1P9
- OL=H
+ SIGN
OL MV-1HZ
1 HZ SQ WAVE
GND
50HZ CLOCK
ATTENUATOR LOGIC 2
GND
ATTENUATOR LOGIC 4
SPARE
+12 V
ATTENUATOR LOGIC 8
ATTENUATOR LOGIC 1
ATTENUATOR DISPLAY
A1A4
A1P10
ZERO CONTROL
LOCAL/REMOTE
REMOTE DUMP COMMAND
REMOTE DUMP COMMAND
METER AUDIO SIGNAL
SLIDEBACK CONTROL
ATTENUATOR ADD
ATTENUATOR SUBTRACT
BAND STEP DOWN
BAND STEP UP
RMS
PEAK
CAL CONTROL
A1P13
REMOTE TUNE
CW
10K
ZERO
A1R1
A1R14
22K
+12V
CAL
A1S9
BLANKING OUT
A1S1
POWER
OFF
ON
-6V
A1S3
LOLAL/REMOTE
1 LOCAL
REMOTE
TUNE GND
TUNE VOLTS
K
L
A1CR1
1N727
A1CR2
1N965
A1R12
6.8K
A1R15
220K
CHARGE
A1DS-1
A1R9
31.6 K
1%
A1R10
31.6K
1%
N.O.
N.C.
ATTENUATION dB ADD
A1S8
AVG
PEN2
PEN2 RMS/PEAK
A1S20
A1S7
ATTENUATION dB SUBTRACT
A1S10
STEP UP
A1S11
STEP DOWN
+6V
-12V
22
20
1
9
15
SWEEP START
A1S15
SWEEP START
A M METER
A1S2
BATTERY TEST
A1R2
THRESHOLD
10K
A1R3
+12V
A1R16
220K
OFF
ON
TIE POINT
AFC
A1S14

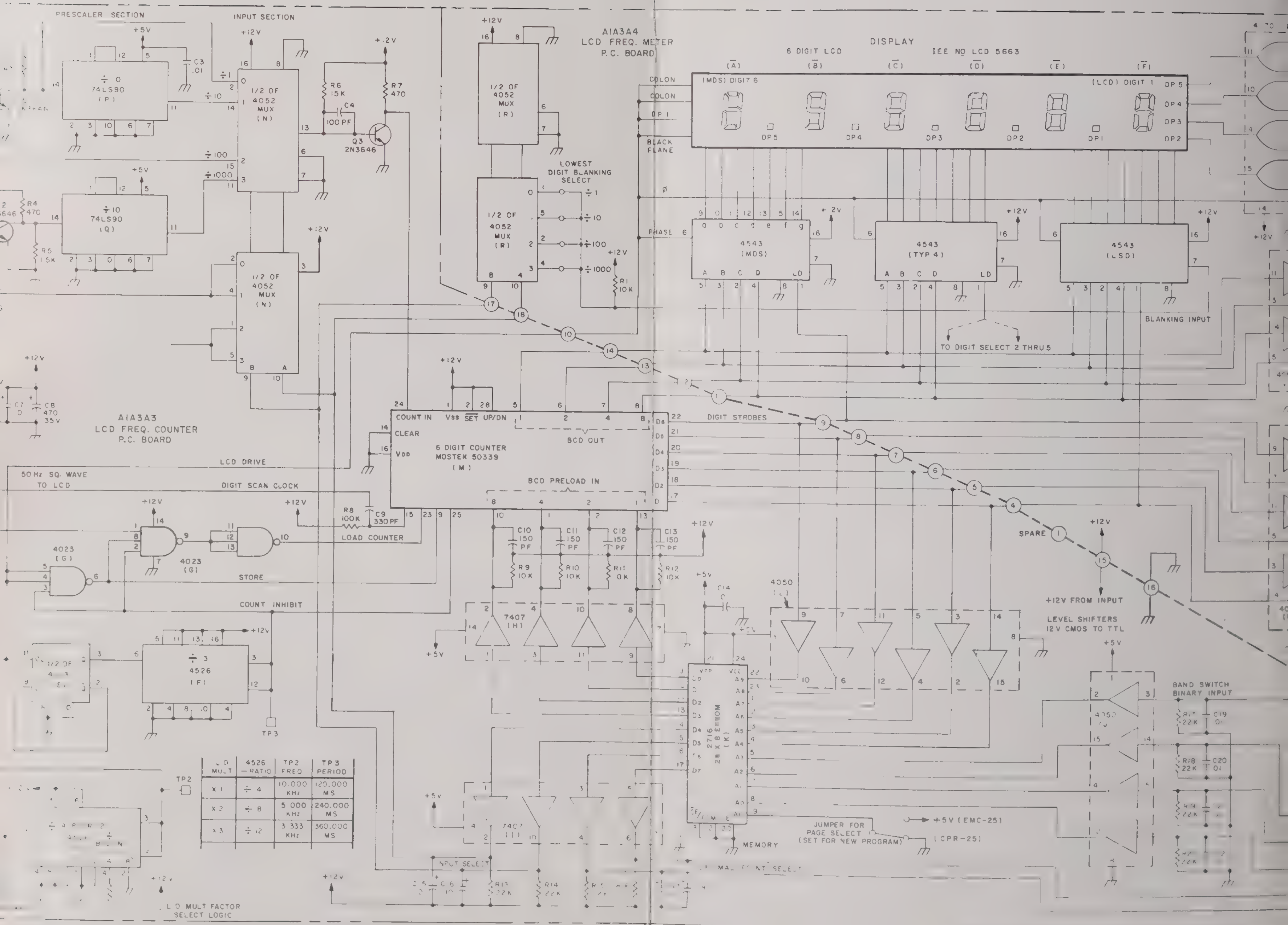


NOTES: UNLESS OTHERWISE SPECIFIED:

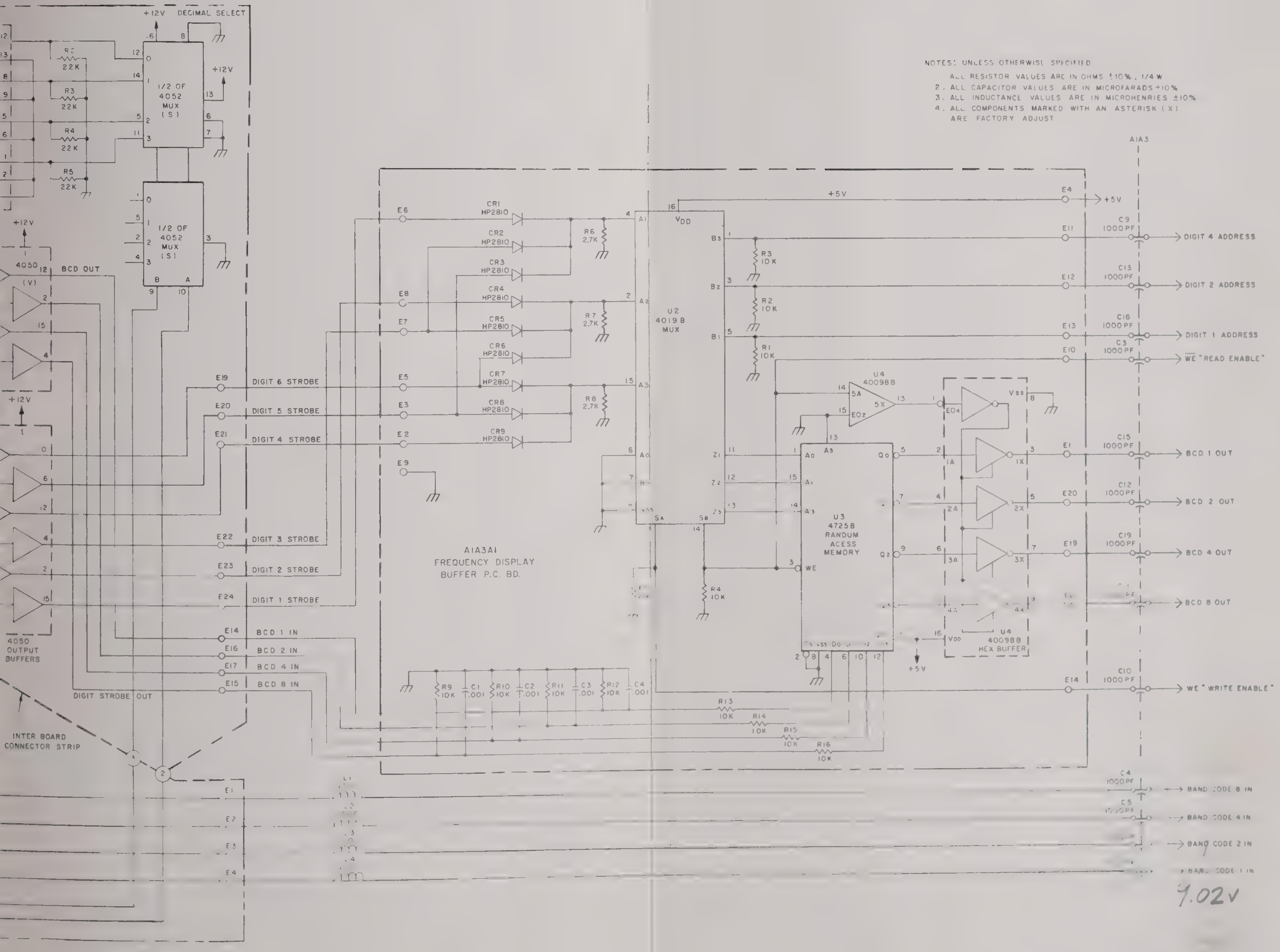
1. ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%.
3. ALL COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.

Figure 6.35
Control Section Interconnections


A1A3
A1A3-J1
L.O. INPUT
A1A3A2
REGULATOR FREQ. DISPLAY
P.C. BOARD
E5
+RAW
K1
712TN26
1
10
R1
47K
E10
4
2
R10
470
E3
9
3
6
E6
8
7
E7
BANDS 1-9 IN
.184 MHz TO 14.1 MHz
BANDS 10-15 IN
14.1 MHz TO 1098.7 MHz
A1A3A5
A1A3A2-P2
J2
LVFF÷100
J2
INPUT
J3
OUTPUT
PRESCALER
+V
L.O. IN
J3
A1A3A3-P3
+ RAW
(+20 INPUT)
FL6
E2
+ RAW
C2
22
35V
12
11
V+
Vc
7
U1
µA 723
V OUT
10
Q2
TIP 120
5
CL
2
6
VREF
CS
3
COMP
INV
13
4
+12V
E11
+12V SUPPLY OUT
U3
µA 7805
OUTPUT
3
E1
+5V REG
1
INPUT
COMMON
2
+12V
C4
22
35V
L1
47
U2
µA 78G
C3
.001
R6
4.8K
1%
OUT
3
IN
2
CONT
COMM
4
1
R8
2.26K
1%
R9
5.11K
1%
C6
1
C5
.47
R4
2.2K
R5
*
R7
7.32K
1%
REMOTE
"DISPLAY OFF"
C14
.001
CR1
1N3064
E9
LOCAL
"DISPLAY OFF"
C7
.001
E8
R2
10K
R3
10K
Q1
2N2222
A1A3
R
22K
C
4700 PF
R3
22K
C2
4700 PF
RELAY CONT
+5V
+12V
÷100
45188
4.00 MHz
OSCILLATOR
VECTRON
(A)
+12V



L.O. MULT	4526 ÷ RATIO	TP2 FREQ	TP3 PERIOD
X 1	÷ 4	10.000 KHz	120.000 MS
X 2	÷ 8	5.000 KHz	240.000 MS
X 3	÷ 12	3.333 KHz	360.000 MS

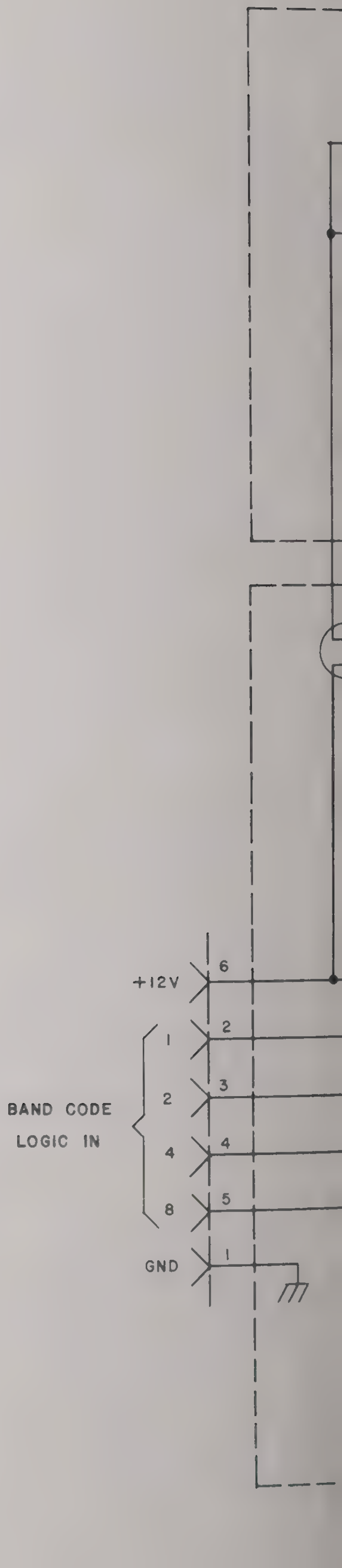


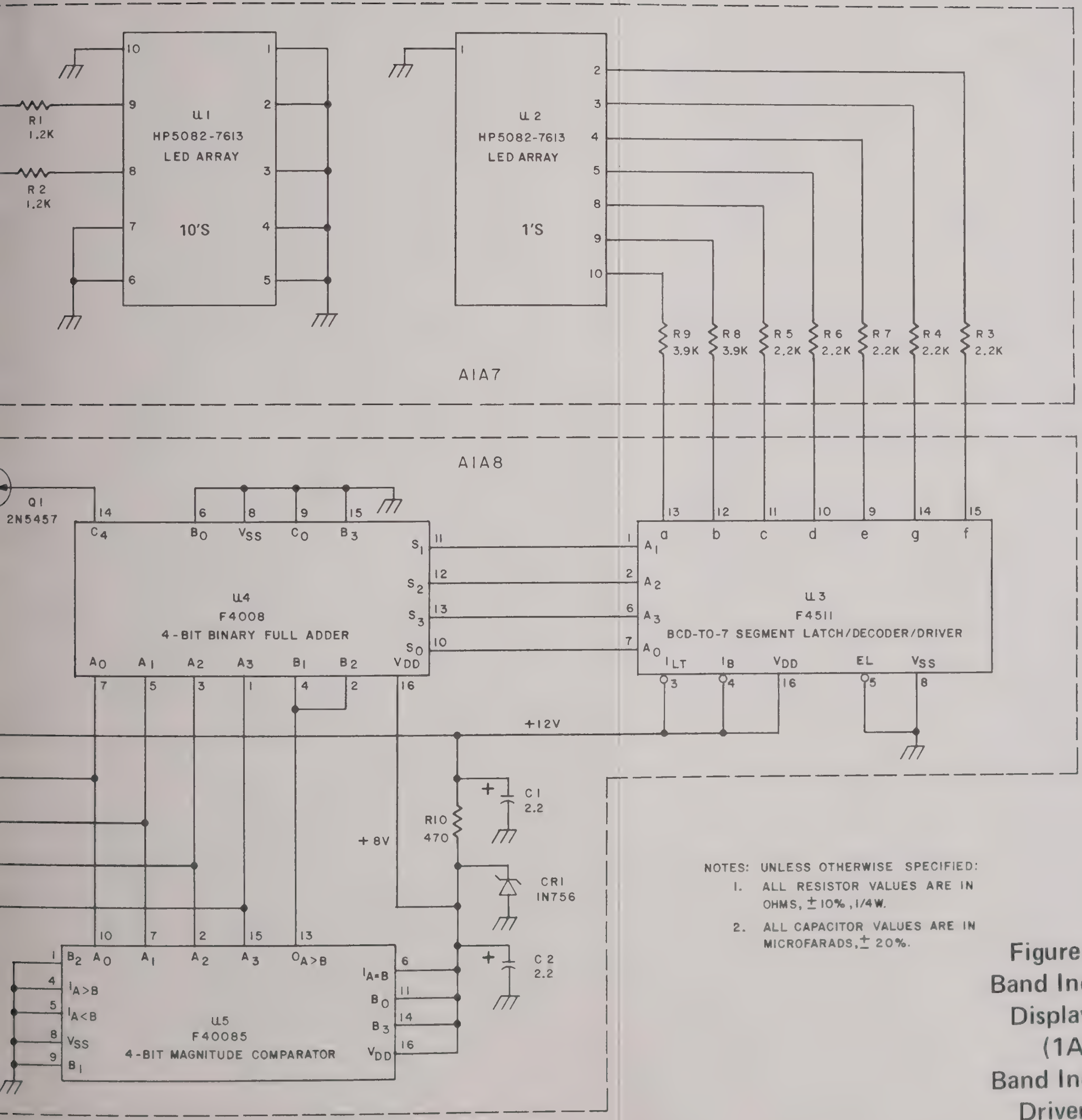
NOTES: UNLESS OTHERWISE SPECIFIED

ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%
4. ALL COMPONENTS MARKED WITH AN ASTERISK (X) ARE FACTORY ADJUST

7.02v

Figure 6.36
Frequency Display
Assembly (A1A3)

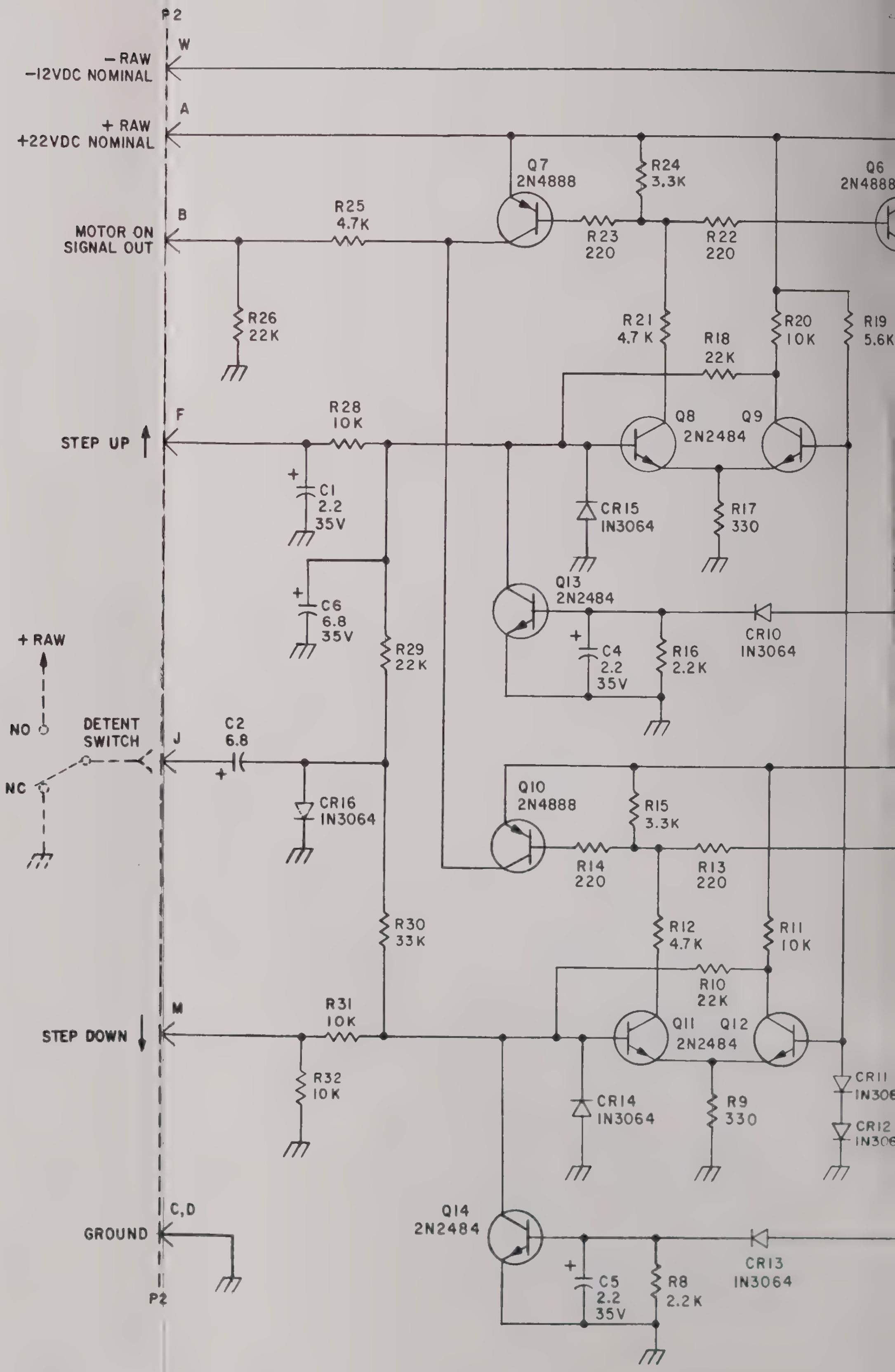

+12V
BAND CODE
LOGIC IN
GND

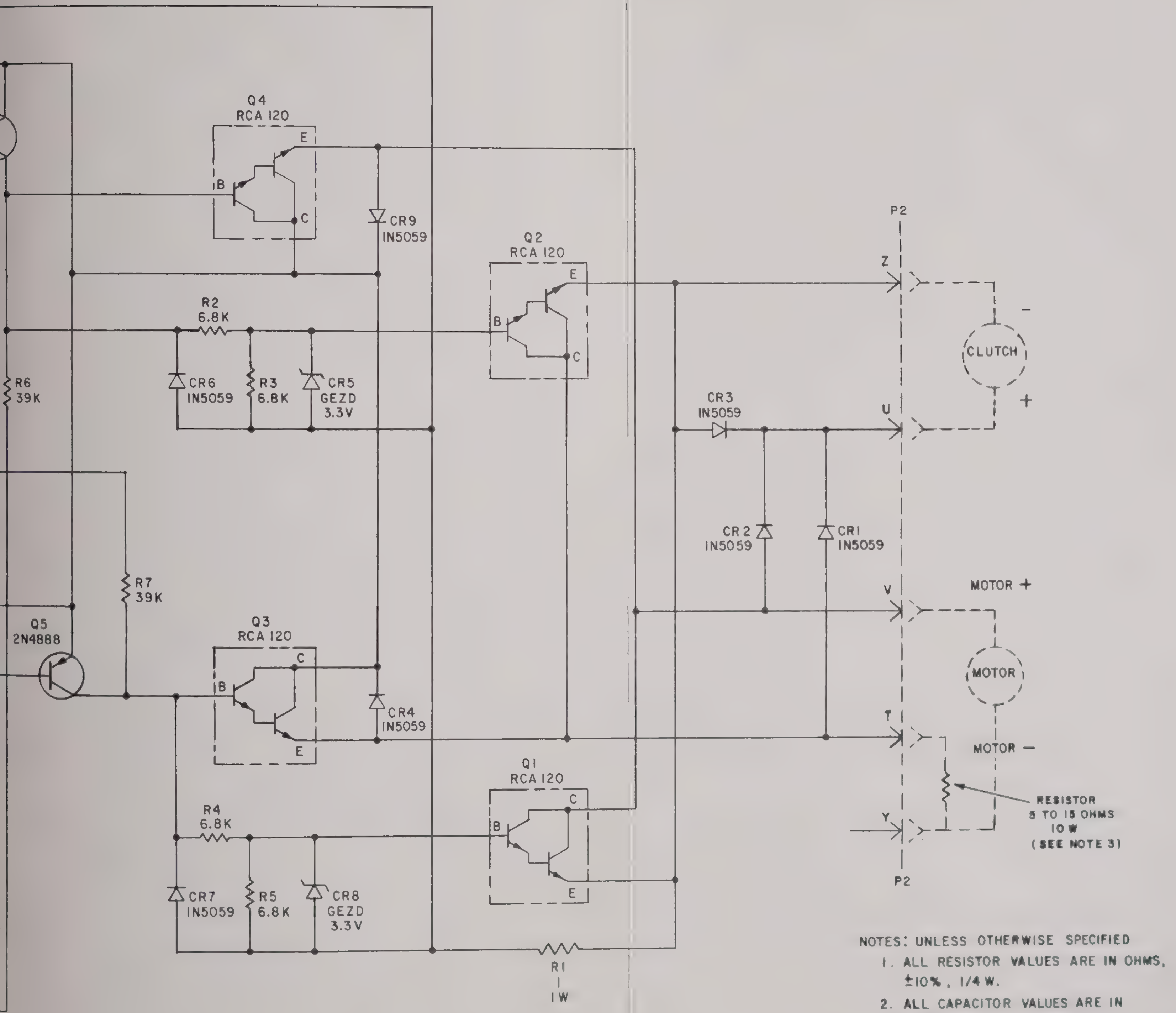


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS, ± 10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%.

Figure 6.37
Band Indicator
Display BD
(1A7)
Band Indicator
Driver BD
(A1A8)

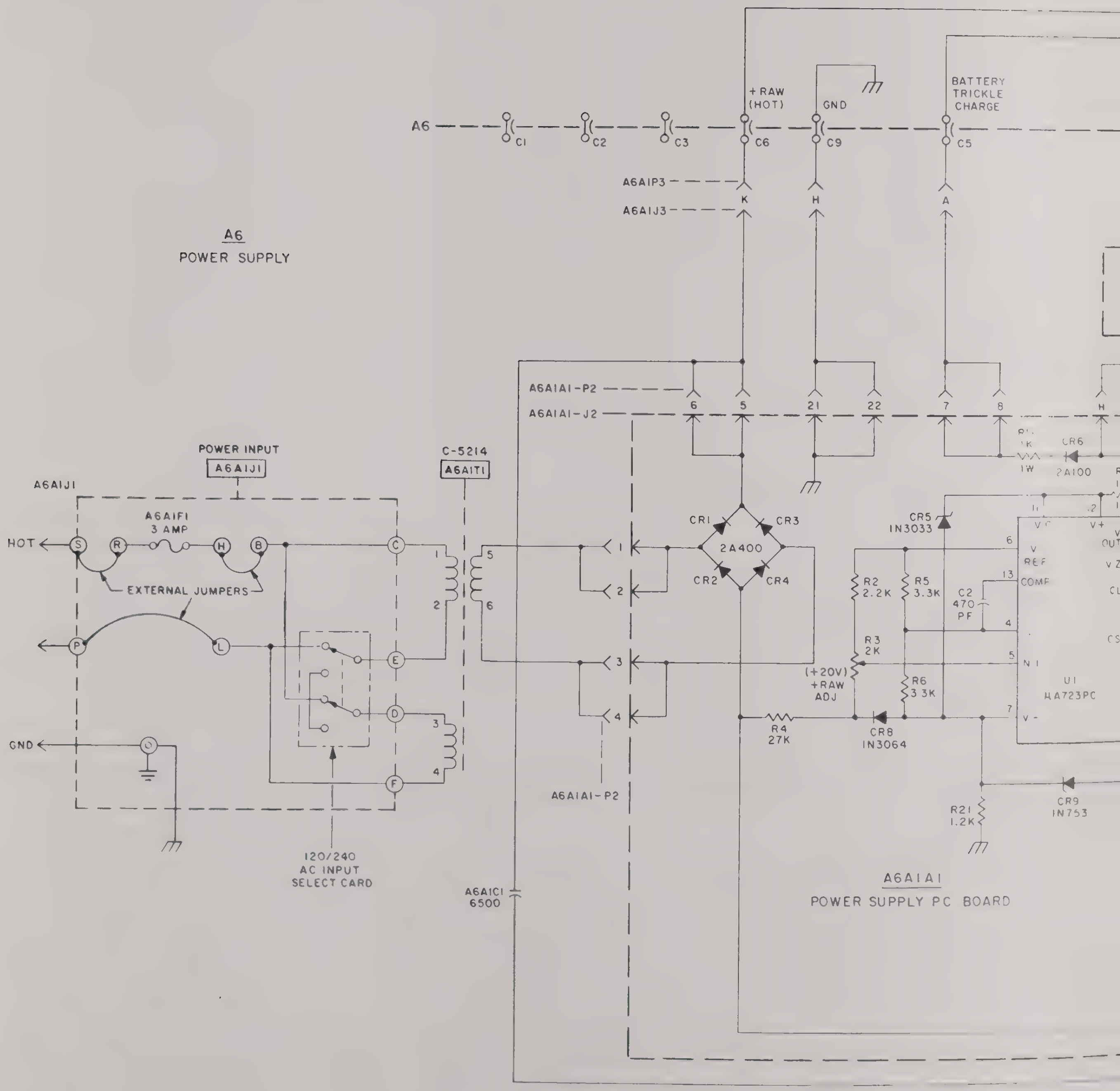

P2
W
– RAW
–12VDC NOMINAL
A
+ RAW
+22VDC NOMINAL
Q7
2N4888
R24
3.3K
Q6
2N4888
B
MOTOR ON
SIGNAL OUT
R25
4.7K
R23
220
R22
220
R26
22K
R21
4.7 K
R20
10K
R19
5.6K
R18
22K
F
STEP UP
R28
10K
Q8
Q9
2N2484
C1
2.2
35V
CR15
IN3064
R17
330
Q13
2N2484
C6
6.8
35V
C4
2.2
35V
R16
2.2K
CR10
IN3064
+ RAW
R29
22K
NO
DETENT
SWITCH
J
C2
6.8
NC
CR16
IN3064
Q10
2N4888
R15
3.3K
R14
220
R13
220
R30
33K
R12
4.7K
R11
10K
R10
22K
M
STEP DOWN
R31
10K
Q11
Q12
2N2484
R32
10K
CR14
IN3064
R9
330
CR11
CR12
C,D
GROUND
Q14
2N2484
CR13
IN3064
C5
2.2
35V
R8
2.2K
P2

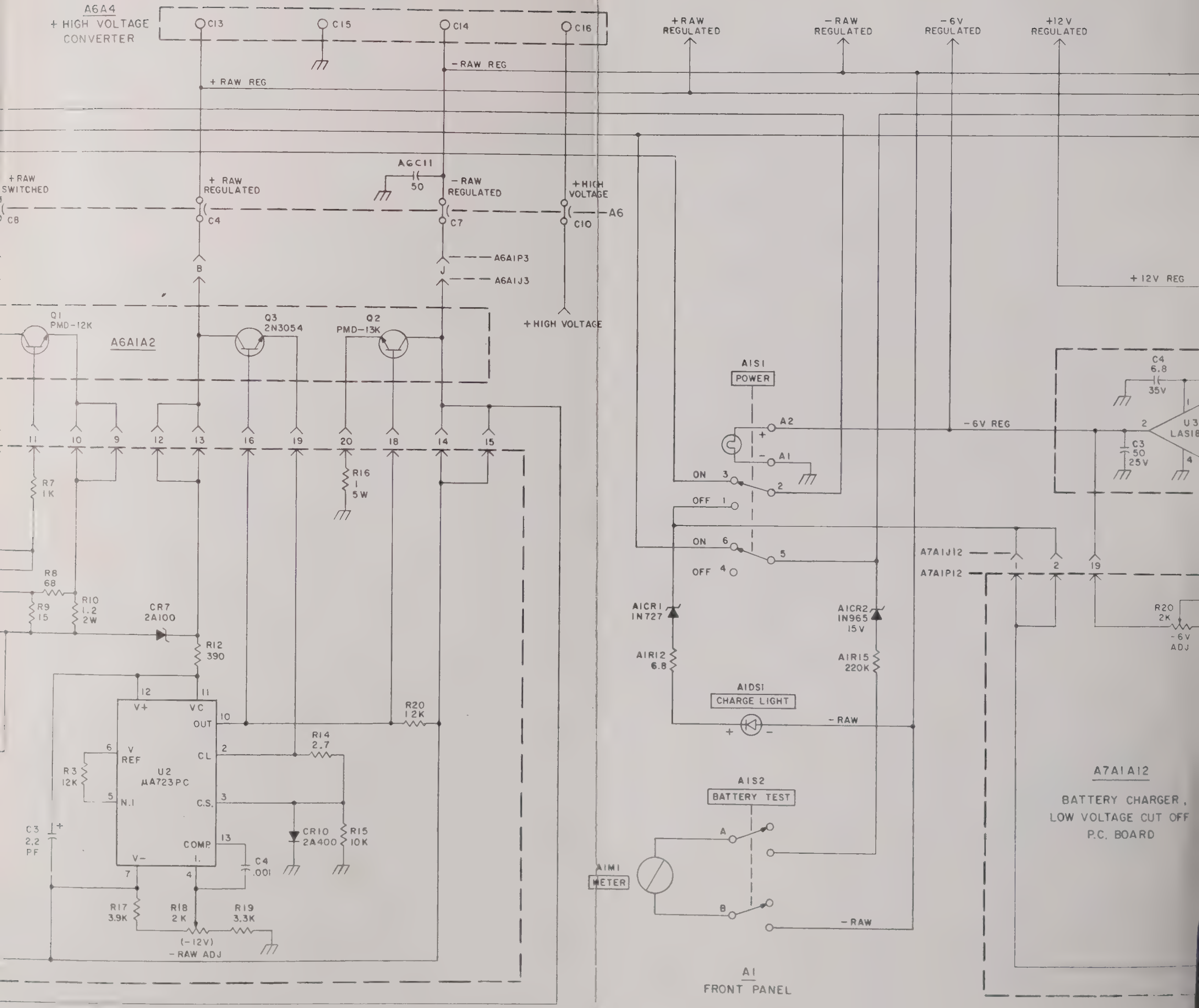


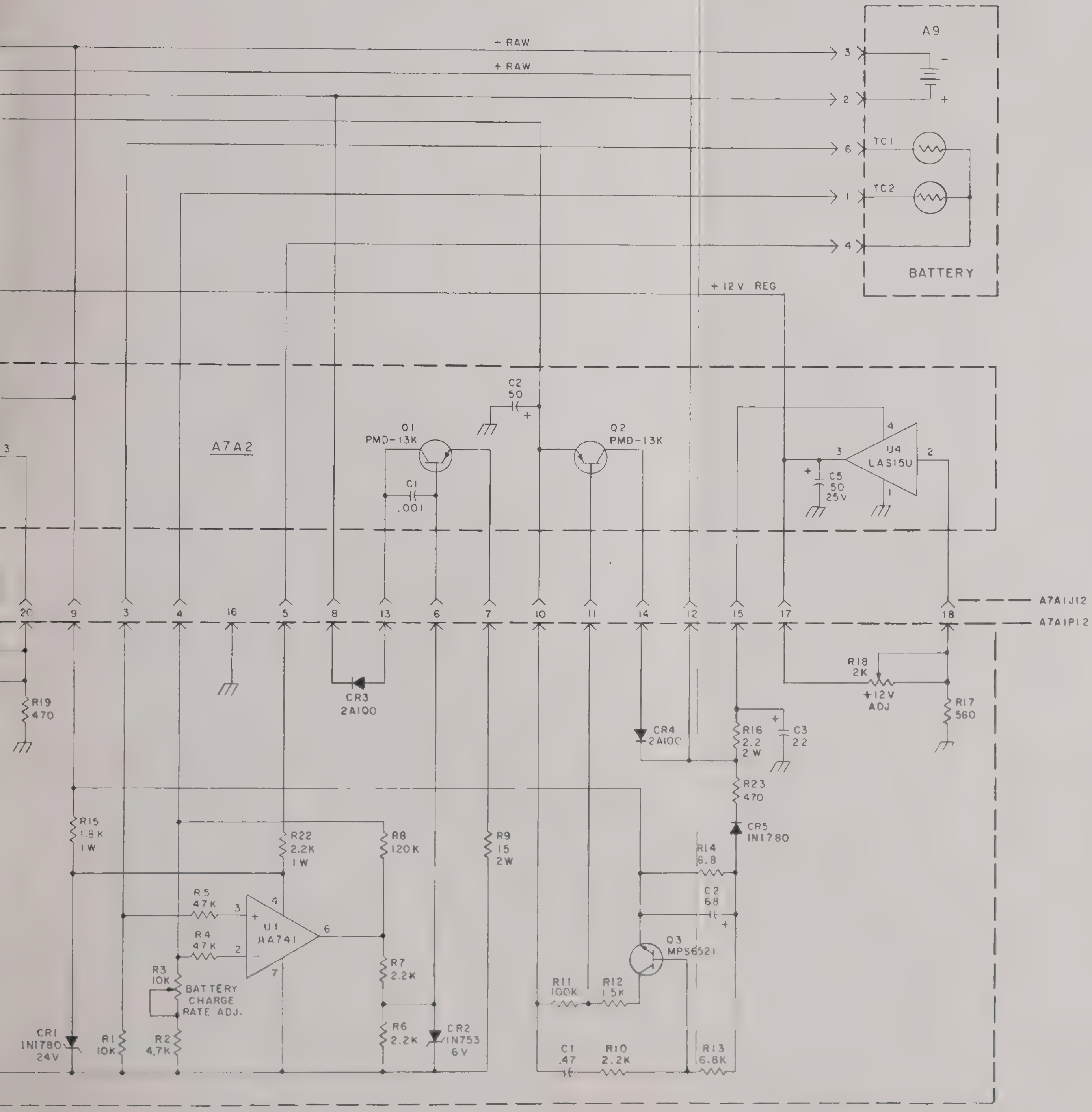
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%.
3. IF RESISTOR IS NOT USED, MOTOR (−) IS TIED TO PIN "T".

Figure 6.38
Band Control Bd (A6A3)


A6
POWER SUPPLY
A6
C1
C2
C3
+ RAW (HOT)
C6
GND
C9
BATTERY TRICKLE CHARGE
C5
A6A1P3
A6A1J3
K
H
A
A6A1A1-P2
A6A1A1-J2
6
5
21
22
7
8
H
1K
1W
CR6
2A100
POWER INPUT
A6A1J1
A6A1J1
C-5214
A6A1T1
A6A1F1
3 AMP
HOT
S
R
H
B
C
EXTERNAL JUMPERS
P
L
E
D
F
GND
1
2
5
6
3
4
120/240
AC INPUT
SELECT CARD
1
2
3
4
A6A1A1-P2
CR1
CR3
2A400
CR2
CR4
CR5
1N3033
R2
2.2K
R5
3.3K
C2
470
PF
R3
2K
(+20V)
+RAW
ADJ
R6
3.3K
R4
27K
CR8
1N3064
R21
1.2K
CR9
1N753
6
13
4
5
7
V REF
COMP
NI
V-
V+
U1
μA723PC
A6A1C1
6500
A6A1A1
POWER SUPPLY PC BOARD

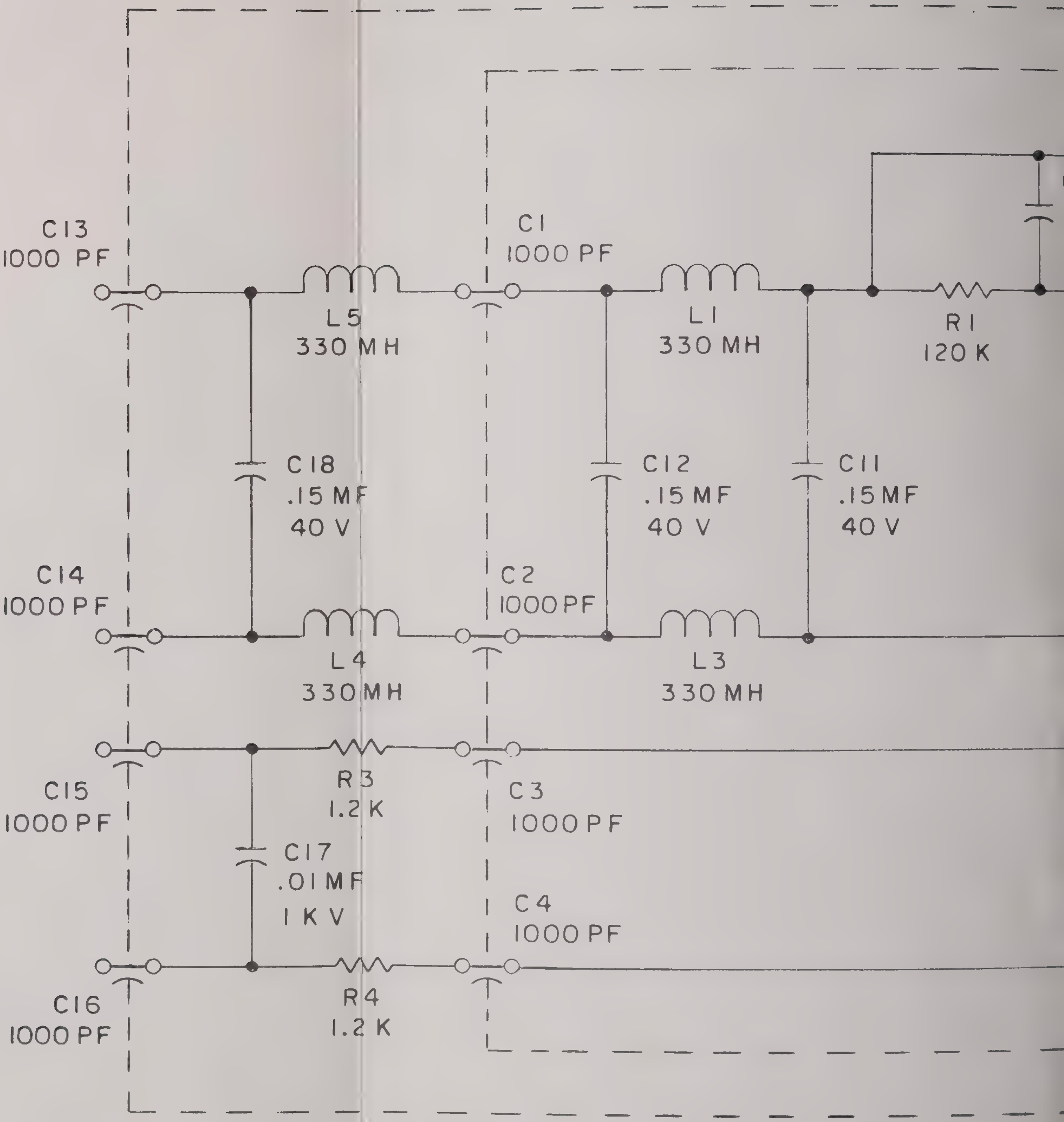

A6A4
+ HIGH VOLTAGE
CONVERTER
C13
C15
C14
C16
+ RAW
REGULATED
- RAW
REGULATED
- 6V
REGULATED
+12 V
REGULATED
- RAW REG
+ RAW REG
A6C11
50
+ RAW
SWITCHED
C8
+ RAW
REGULATED
C4
- RAW
REGULATED
C7
+ HIGH
VOLTAGE
C10
A6
A6A1P3
A6A1J3
B
J
+ HIGH VOLTAGE
+ 12V REG
Q1
PMD-12K
A6A1A2
Q3
2N3054
Q2
PMD-13K
11
10
9
12
13
16
19
20
18
14
15
R7
1K
R16
1
5W
R8
68
R9
15
R10
1.2
2W
CR7
2A100
R12
390
12
11
V+
VC
OUT
10
6
V
REF
U2
μA723PC
CL
2
R3
12K
5
N.I
C.S.
3
COMP.
13
V-
I.
7
4
C3
2.2
PF
R20
12K
R14
2.7
CR10
2A400
R15
10K
C4
.001
R17
3.9K
R18
2 K
R19
3.3K
(-12V)
- RAW ADJ
A1S1
POWER
A2
A1
ON
3
2
OFF
1
ON
6
5
OFF
4
A1CR1
1N727
A1R12
6.8
A1CR2
1N965
15 V
A1R15
220K
A1DS1
CHARGE LIGHT
- RAW
A1S2
BATTERY TEST
A
B
A1M1
METER
- RAW
A1
FRONT PANEL
- 6V REG
C4
6.8
35V
1
2
U3
LAS18
C3
50
25V
4
A7A1J12
A7A1P12
1
2
19
R20
2K
- 6V
ADJ
A7A1A12
BATTERY CHARGER,
LOW VOLTAGE CUT OFF
P.C. BOARD



NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE FACTORY ADJUST.

Figure 6.39
Power Supply
Assembly (A6)



NOTE

UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE I
OHMS, ± 10%, 1/4 W.

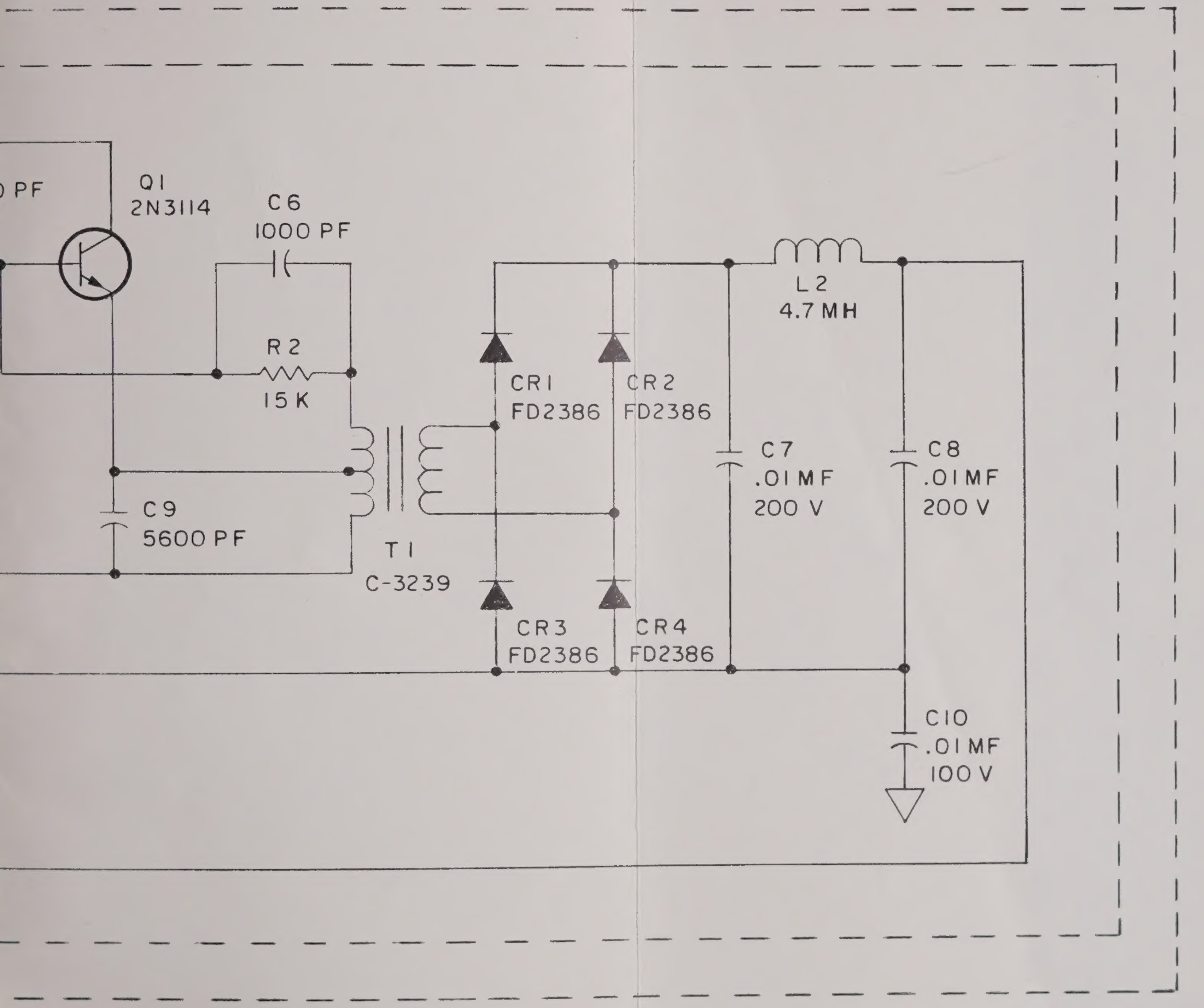


Figure 6.40
H.V. Connector
(A6A4)

MP MASTER
MA32017

MP MASTER
MA32017